73 AMATEUR RADIO

HOLIDAY 1976
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the TR-7400A

Featuring Kenwood's New and Unique CONTINUOUS TONE CODED SQUELCH SYSTEM

4 MHz BAND COVERAGE

25 WATT OUTPUT

FULLY SYNTHESIZED

UNIQUE SQUELCH SYSTEM
The TR-7400A may be used on your favorite repeater, no matter what type of squelch system is used. The continuous tone coded squelch (CTCS) may be used for both transmit and receive or for transmit only. Tone burst operation may also be used.

SYNTHESIZED, 800 CHANNELS
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REPEATER OFFSET
A convenient front panel switch offsets the transmit frequency of the TR-7400A up OR down 600 KHz for standard repeater operation. This offset circuit uses digital technology to provide a highly stable offset frequency without spurious response. A dual color LED indicates the direction of offset from the displayed receive frequency.

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Large-sized helical resonators with high Q minimize undesirable interference from outside the 2-meter band. The large helical resonators, 2 pole 10.7 MHz monolithic crystal filter, and MOSFET front-end circuitry combine to give outstanding receiver performance.

TONE PAD CAPABILITY
A jack is provided to allow convenient connection of a tone pad to the TR-7400A.

FINAL PROTECTION CIRCUIT
The final transistor in the TR-7400A is protected from antenna impedance mismatch. Excessive reflected power reduces the amount of drive to the final transistor rather than turning off the final stage. This practical feature allows continued safe operation at a reduced power level whether the antenna system becomes opened or shorted.

Specifications TR-7400A

- Range: 144.00 MHz to 147.995 MHz
- Mode: FM
- 800 Channels: 5 KHz spaced
- Sensitivity: Better than 0.4 uV for 20 dB quieting
  Better than 1 uV for 30 dB S/N
- Squelch Sensitivity: Better than 0.25 uV
- Selectivity: 12 KHz at −6 dB down
  40 KHz at −70 dB down
- Image Rejection: Better than −70 dB
- Spurious Interference: Better than −60 dB
- Intermodulation: Better than 66 dB
- Receive System: Double conversion
- First IF: 10.7 MHz
- Second IF: 455 KHz
- Audio Output: More than 1.5 Watts (8 ohm load)
- RF Output Power: 25 Watts (High)
  5-15 Watts (Low-adjustable)
- Antenna Impedance: 50 ohms
- Frequency Deviation: ±5 KHz
- Spurious Response: Better than −60 dB
- Tone Pad Input Impedance: 600 ohms
- Tone Burst Duration: 0.5 to 1.0 sec.
- CTCS Range: 88.5 Hz to 156.7 Hz
- Microphone: Dynamic, with PTT switch, 500 ohms
- Voltage: 11.5 to 16.0V DC (13.8V DC nominal)
- Current Drain: Less than 1A in receive (no input signal)
- Current Drain: Less than 8A in transmit
- Polarity: Negative ground
- Temperature Range: −20 to +50 degrees C
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  270 mm (10-5/8") deep
  74 mm (2-7/8") high
- Net Weight: Approximately 2.8 kg (6.2 lbs.)

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

ASPEN CONFERENCE

With the amateur radio industry in a turmoil as a result of the high input of CBers into the Novice ranks, the low band Novice privileges of the Techs, the possible loss of 220 to the CB industry (CBers don't *want* it), the even worse disaster possible to the low band frequencies if ARRL continues to do its best to prevent preparation for the WARC, manufacturers going direct in sales as dealers fold up, and dealers caught between low markups, price cutting, high advertising costs and shortages of supply, it is time for everyone to get together for a few days and see if anything can be done which will work out better for the long range benefit of the hobby and bring more business to everyone involved.

Such a meeting has been arranged for the week of January 8-15th in Aspen, Colorado. Here, with over 100 restaurants to pick from, there will be a series of extended dinner meetings so the ham industry can discuss its problems and work out some possible solutions. Manufacturers, dealers, and just plain interested hams are invited to join the group in Aspen for some skiing, some relaxation, and a lot of serious business.

I'll be there to help as a catalyst and perhaps bring some perspective to things like the coming Communicator Class license (*my* proposal, in case you've forgotten), the state of the CB industry at present (I write a CB newspaper column), and things like that. Chuck Martin WA1KPS (Tufts Radio), the largest New England ham distributor, will be there to discuss the viewpoint of the ham dealer. It should be a very valuable meeting ... and fun.

We'll be staying at the Continental Inn, which is near the center of town. You can probably get rooms if you get right at it by calling Aspen Reservations. Look for a place with a sauna and heated pool, if you can get it ... that eases the aching muscles after skiing and makes dinner a lot more pleasant.

If you're a good skier, you'll probably be lunching with us on top of the Aspen mountains. If your skiing needs some repair, they have the best ski instructors in the world at Aspen. I went from a rank beginner to a high intermediate in one week at Aspen.

If you are going to join us at Aspen, please let me know as soon as possible so I can arrange for you (and anyone with you) at the dinner meetings.

FOOTNOTE IN MOUTH DISEASE

If you are a League member who gets hot under the collar every time I mention the ARRL, rather than get mad every time I go negative on 'em, why not check out the facts and correct *me* if I'm wrong ... and correct the *ARRL* if I'm right? The newspages of *73* are wide open for anything like that.

Now, to the matter at hand ... or foot, in this case. I've mentioned before about the long standing policy of *QST* to delete footnotes in articles referencing *73*. This is a bit hard on readers because *73* publishes about four times as many articles as *QST* and thus it is almost impossible to write any technical articles for *QST* without having some *73* references ... often a raft of them. Is the value of the *QST* articles degraded by these deletions?

The recent *QST* series on microprocessors gave no reference to any of the 70 articles so far published in *73* on the subject. Was that honest? By far the biggest laugh on this was the October *QST* cover article by Tilton on the planets and radio propagation ... with all sorts of talk about the originator of the idea, John Nelson, but without a single mention that he has for many years been the Propagation editor of *73* and has had many articles in *73*. I'll bet they get a hard time over *that!*

Many of you recall the little incident of the "Lifted Counter" where K2OAW'S counter circuit was lifted almost intact and published two years later in *QST* as an original construction project ... with not one mention of Stark or *73*. Since the K2OAW counter has been extremely popular and built by more hams than all other types of counters combined, it was hardly an oversight.

Well, never mind ... *73* will continue to reference any and all ham magazines in articles ... even *CQ*, should the occasion ever arise.

INSTANT DVM

It is not a very well kept secret that Motoroia is getting ready to deliver their digital voltmeter chip (14433) which will sell for around $20 in single lots and probably be available via Godbout and others for much less than that.

This little dandy requires a small power supply, a two volt reference, and a 3½ digit display. It may require a display buffer. It has a 1000 megohm input and auto polarity, and all that sort of good thing. The result is going to be very low priced DVMs and perhaps DVMs being built into the newer rigs, since they will be cheaper than a panel meter.

In steps the microprocessor again (sorry about that, tubers). With a very simple processor the DVM circuit can check out just about every circuit of a transmitter or receiver (or anything else) and report deviant behavior. The DVM can use the real time clock readout (you might as well use the processor as a clock, too) to report on any voltage you want to monitor ... or current, or to tell you when something is out of spec.

HIJACKING PLANES

After a few trips by air I've gotten the hang of what I can or cannot get through the baggage inspection stations. Since I need a small knife to open packages shipped for use at hamfests, I always used to pop my little Swiss Army knife in my camera bag. It was handy, with a built-in scissors, screwdriver, file and things like that.

The first time I tried to get that through the inspection team they viewed it with the same reaction you might expect if they found an automatic gun in my bag. They rushed me into a room and I was grilled for a half hour by an idiot with a Kojak haircut and a breath that could only have resulted from a raw onions and cigar sandwich. I managed to convince them that it was just a blunder on my part, so they sent my knife along in a sealed bag for the captain to take along and have delivered to me at my destination ... after I was safely off the plane.

Okay ... no pocketknives. The next serious brush with the paranoiacs came when I attempted to get through the gauntlet with a pair of scissors. In packing up after the Dayton Hamvention I'd ended up with the scissors used to cut the packing tape. They went into my camera bag. Bad news. As they were trying to get me into the Dayton grilling room I offered to settle out of court and bribed them with the scissors. I figured it was cheaper to buy another pair than miss my plane.

Okay ... no pocketknives or scissors.

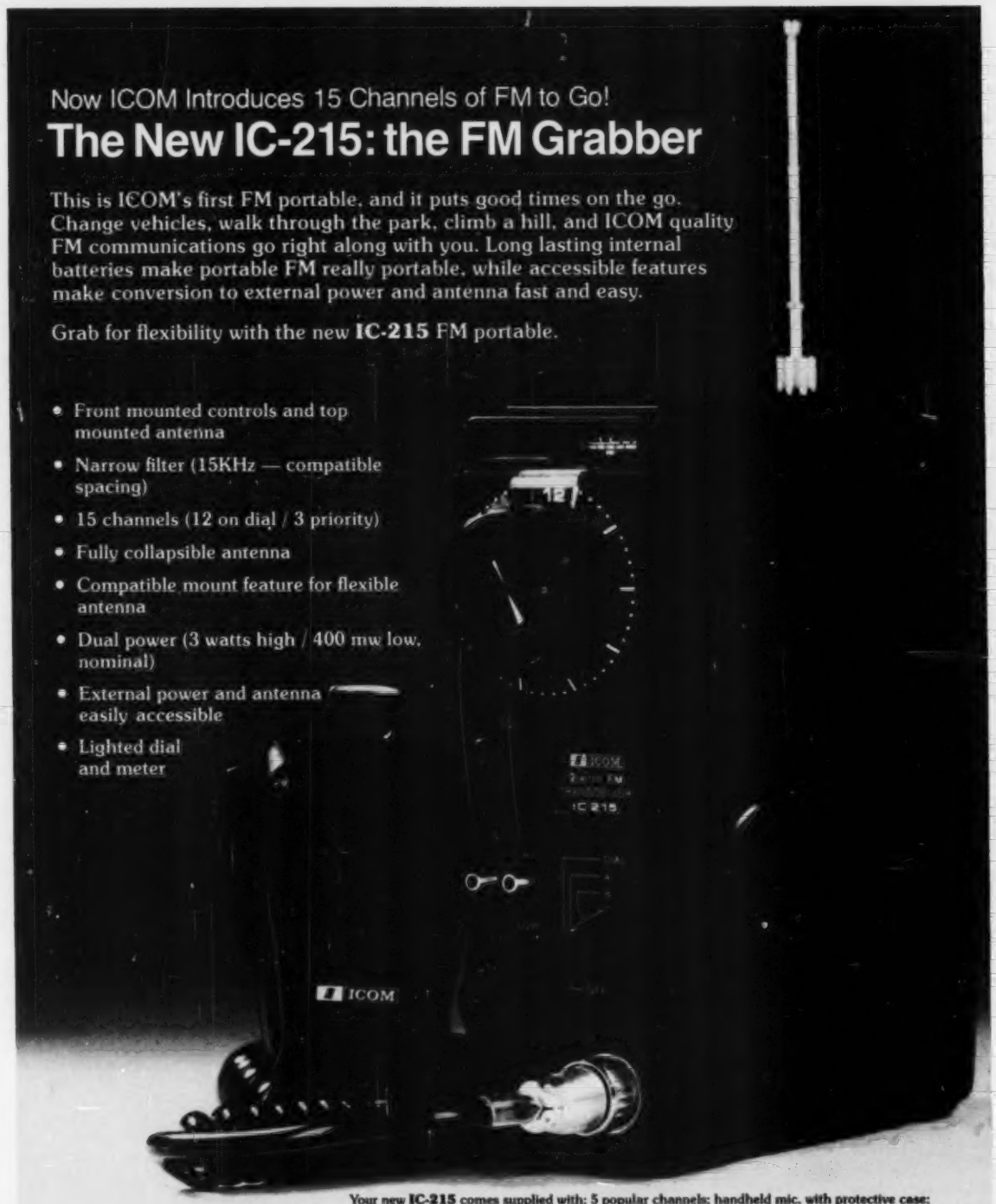
Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215** FM portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial / 3 priority)
- Fully collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter



Your new IC-215 comes supplied with: 5 popular channels; handheld mic, with protective case; shoulder strap; connectors for external power and speaker; 9 long-life C batteries.

VHF UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

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The next time the lights started flashing and bells ringing it was a dental pick in my camera bag. I had a tooth that was trying to die and my dentist had given me an emergency kit to stave off the inevitable. Did these clowns figure that I was going to hold the passengers and crew of a DC-10 at bay with a lousy dental pick? Yes . . . that's what they thought. The captain gave it to me when I reached my destination.

I must admit to reading with just a twinge of satisfaction about the chap who went aboard a plane with a bunch of plastic explosives on his belt.

CB DEBACLE PROFITS HAMS

CB rigs are going for a "dime a dozen" these days, figuratively speaking, and this is a great opportunity for hams to take advantage and get some gear cheap – good gear.

Many, if not most, of the CB rigs can be moved up 2 MHz so they will perk away on 10 meters.

Most of you are aware of what happened to the CB market . . . it bombed. I attended a meeting of CB manufacturers and dealers recently (*73* was the *only* ham magazine present, by the way). I was more interested in what schemes they had going for them for 220 MHz than in their miseries with price cutting and dealer dumping, etc.

Here's what happened. Back last spring when CB was in all the papers and appearing on TV shows, the public went ape over CB and just about anything made to look like a CB set was selling. The FCC was getting 500,000 license applications a *day*. Dealers were being badgered by customers for sets and dealers in turn were driving manufacturers up the wall with orders and demands for delivery. New factories were built as fast as they could be built, hi-fi factories in Japan were turned into CB plants, customers went from dealer to dealer trying to place orders, and the dealers, in turn, passed the orders along to the manufacturers.

By summer the heat was dying down a bit. Millions of CB sets were being turned out in the U.S. and every ship available was loaded to the Plimsol line coming from Japan, Taiwan and Singapore. FCC license applications dropped off to 100,000 a day and dealers began to find that their "customers" had ordered from five or ten other dealers and had long since bought a rig. Shelves began to droop with the unsold sets . . . then storage areas filled up . . . then warehouses. And still the sets came, pouring off ships, filling rented emergency warehouses, stuffing trailer trucks.

By August first, the FCC was down to 90,000 applications a day and then they dropped the big bomb . . . 40 channel sets can be sold in January! Panic! "How in the hell are we going to sell obsolete 23 channel sets when the public is waiting for 40 channels?" In one move the FCC had killed the whole Christmas season for the CB industry – it could lose them billions of dollars.

To make matters worse, a couple of petitions were filed to prevent the expansion to 40 channels – filed by TV groups who wanted to try and prevent interference to channel 6 like that being suffered by channel 5. The third harmonic of the present sets raises the devil with channel 5 and the new higher channels would probably do the same to channel 6. The FCC has to decide soon whether to throw out the expansion or not . . . and the decision could go either way.

If the FCC decides against the TV groups, then it could still go to court and take months to years for a decision.

By September, just to help out, the FCC announced that CB applications had dropped to about 75,000 a month. This is big as far as hamming is concerned, where we have maybe 150,000 hams who could be considered active, but by CB standards it is a disaster.

This is going to be a great time to get some incredible buys on 11m rigs. If we can get some good conversions to ham channels, we have an opportunity to get good ham gear at perhaps 30% of what it might otherwise cost. I'll be most interested in simple conversions of popular CB rigs to 10m and some sort of plan for setting up standard channels on 10m so we can all intercommunicate. Who knows, perhaps we can get started on some 10 meter repeaters while the band is still suffering from sunspotlessness. How about some articles?

COMPLAINT AGAINST YOU

Mary is pretty upset – and she has a right to be – for you've been letting her down. Mary is the incredibly gorgeous girl who handles the reader's service requests. We have to keep her locked up in a secret inside room if we want any of the fellows here to get any work done; otherwise they hang around and keep Mary busy talking – and Mary is a talker.

Her complaint is that after all of the trouble and expense of having a reader's service card bound into the magazine so you can send for information without tearing a page out of your magazine, there are still thousands of readers who are *not* sending in the cards. Poor Mary – she's in tears some days when only a couple hundred cards come in.

You can keep Mary a lot happier if you tear out that card, circle the info you want and send it in. This will also make the advertisers happy, and you have a strong vested interest in this too, for the more ads there are in *73*, the more pages of articles you'll get. Simple as that. To keep the cornucopia pouring out every month, you have to encourage the advertisers with reader's service requests . . . and you have to let them know it when you buy something that has been advertised in *73*.

MORE DELOGGING REQUESTED

Though most of the logging requirements for amateur stations were deleted some months back, the requirement to keep a log of all third party traffic hung in there, much to the irritation of repeater groups, who had to keep making tapes of all autopatch contacts and saving them.

T-MARC, The Middle Atlantic FM and Repeater Council, has petitioned the FCC to delete this requirement, pointing out that the Commission has not in fact made much (if any) use of these tapes.

It will be interesting to see how the Commission reacts to this request for further deregulation.

YAESU GIVES $29

Yaesu Electronics Corp. has announced that they will pay anyone who gets his first ham ticket between November 1, 1976 and June 30, 1977 a bonus of $25 plus $4 reimbursement for the cost of the ham license. To qualify, you must have purchased a Yaesu FT-221 (the 2m SSB-FM-AM-CW transceiver) from an authorized Yaesu dealer. A copy of the license and the bill of sale will bring the bonus.

Big deal, you say? When you consider that there are several million CBers out there who are candidates for ham tickets and that the Yaesu nationwide publicity and advertising program for the above bonus will undoubtedly stimulate interest in amateur radio, it is indeed a big deal.

APPLYING FOR EMPLOYMENT

My recent plea for help at *73* brought in quite a bunch of resumes, most of them very poorly done.

Look, fellows, when you are looking for a job, you are selling yourself, so make an effort to do just that. For instance, you'll find that few prospective employers are interested in why you want the job. Fellows who write to me and tell me that they would like to live in New Hampshire so they can climb mountains are not convincing me that I really need them with *73*. Fellows who are unhappy with their present jobs and are looking for something else . . . anything else . . . are not very persuasive.

The chap who sends a letter to me giving me the reasons why he will be of value to *73* . . . telling me what he can do and what he would like to learn to do . . . heck, I wouldn't even need an opening for him, I'd make one. What employer will turn down someone who shows how he can increase the income of the firm substantially? Or cut expenses?

Some employers put a lot of stock in schooling . . . I tend more to want to know what a chap has done for his previous employers . . . how much interest he has in learning . . . how much he is into working . . . how well he gets along with others. And the chap who shows that he has enough interest in working for *73* to do some research has a big advantage.

A fellow might visit a few ham stores and get opinions from dealers about ways for us to do better in selling *73* bulk copies to them . . . or in selling the *73* books to them . . . and then write to me and mention that among the things he'd like to do is help with increasing sales through dealers . . . for instance . . . etc. That shows interest, resourcefulness, and imagination . . . and almost any employer will sign you on immediately.

ARRL TO SPEND $800,000

Did the directors vote this enormous sum to help amateur radio prepare for the 1979 ITU conference? No . . . well, perhaps it will be spent on a nationwide publicity and advertising campaign to help amateur radio grow? No . . . the fact is that that half million dollar building everyone pitched in to pay for a few years ago is a bit cramped and rather than either streamline operations or double up a bit, they feel that they really must add to the building. $800,000 worth of addition!

Will we have another building fund drive?

Youngsters may not have heard about the last building fund drive. Let me tell you about it briefly. For many years the League was operating out of West Hartford and putting aside money for a new building. They had about a half million stashed away for this. Then came a new director . . . a shrewd one. Why spend all that money when you can get the members to donate enough for the new building? Sure enough, he was right, and the League ended up with money in both pockets. The part that I enjoyed the most was when they sold the old building for a half million! Who says non-profit organizations can't make money . . . millions of dollars? Since very few members make the effort to get the yearly ARRL report . . . or to read it, hardly any members are aware of what is really going on.

I suggest that the League *should* have another building fund drive to build on the new wing . . . and take the $800,000 and use it to field a couple of ham ambassadors to the smaller countries of the world who will swing the votes in a couple of years . . . the votes which could make that new wing unneeded.

A "bravo" for ARRL director Griggs, the only one with the guts to stand up against Baldwin on this utter waste of membership funds.

NOTE

The Ancient Aviator has not flown the coop – he is merely on vacation. His column will be resumed soon. Also, our Contests, Oscar Orbits, and Propagation columns will continue on a regular basis beginning with the January issue.

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

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LETTERS

GUAM: A WINNER

Just a few lines to let you know that the reprogrammable ID described in your April '76 issue is a winner. My compliments to Bob Glaser WA3MSW and you for publishing a good workable and easily reproducible construction article (my copy of the IDer works great). Myself and some of the others here on Guam are making good headway on setting up a 16/76 machine. Right now, the only circuit I haven't been able to come up with is one which would take the output of a touchtone decoder (NE567s, 7402s, et. al.) and convert it to Ma Bell compatible dial pulsing. If you or any of your readers happen across such a circuit I sure would appreciate it.

More on the 16/76 repeater: Hoped to have it operational about 1 Oct 76, but with the inevitable wait for licensing it could take much longer (ordered my own KG6 secondary call in June with no results so far). At present there are no active repeaters on the island, although members of the Marianas ARC are diligently working (especially K7IRC/KG6) to restore their 34/94 machine. It seems they have a combination of duplexer, control circuit, and site problems at the moment, which don't lend to a speedy solution.

Visitors to Guam should find a welcome reception on 94 simplex in the meantime, and later on (hopefully) both the 34/94 and 16/76 open machines.

Bill Howard K1LNJ/KG6
Guam

So who visits Guam? – Wayne.

TOO GOOD?

I must register my frustration with the quality of *73*. It's *too* good. I take a large number of diversified magazines, but most of them have enough uninteresting material that I can skim them in short order. However, when my monthly *73* arrives, I get nothing else done for days, because *73* is so interesting that I find I must devour every word. Seriously, keep up the fine work. It's really amazing how you consistently maintain such high quality, month after month.

Stan Tippin W4VMR
Niceville FL

Baloney, Stan, it isn't that *good. – Wayne.*

MULESHOER

Since CB radio has become so popular, many of my customers have gotten rid of their telephones and gone exclusively to the CB radio in order to communicate with their friends. That was the reason I got CB for my truck ... I can't confirm appointments by carrier pigeon or smoke signal. And Wayne is right ... it's darned handy. I have found another side benefit of it. I'll tell it by the example of last Saturday night: I was shoeing horses in the Milwaukee area all day Saturday. It was 9:30 or 10:00 pm when I started home, which meant I'd get home sometime around midnight. 70 or 80 of those miles are interstate highway. I put the (ham radio) bug into the ears of a lot of those truckers ... my "handle" is Muleshoer ("horseshoer" tends to come out of the radio sounding like "whore-shoer" and we don't want that!). After the truckers get over the first shock of finding out that there is a female professional horseshoer in the world, they ask a lot of questions. I try real hard to evangelize in the name of hamming, and Saturday night alone there were at least 6 different voices that kept interrupting and asking me for the name of "that magazine with the friendly name." They were all *really* intrigued by the prospect of being able to talk legally with someone several states away. One of them wondered about getting "Smokey reports" from Europe (maybe he drives an amphibious semi?). I keep telling them that "anything 6- and 10-year-old kids can do, they can do, right?" It gets to them, apparently. Even though neither of *us* has been able to scare up the time to go and take our license exams, we have spent a lot of time passing on the word about amateur radio. If *any* of it "takes," it will have been well worth it. I was wondering about the likelihood of getting new blood into amateur radio before Wayne started pushing it in his column(s). Keep it up, Wayne. Just because a lot of those CBers are interested only in "broadcasting" doesn't mean they all are. There is a lot of talent out there that will be wasted as far as ham radio is concerned if we don't *all* get out there and evangelize. What you don't use, you lose, and if we don't get more bodies into ham radio's ranks, we'll lose a lot of our space. It may well be that many CBers will get involved in ham radio because of the crush on the CB channels – as well as out of curiosity about the workings of "that box" under the dash. If we are to keep what we have in the way of air space, we have to welcome them with open arms, and this is truer if we hope to expand our air space. One of the biggest "selling points" of CB radio is its family atmosphere. CB breaks are family affairs. Hamfests don't seem to be. I've never been to a break, but I hear a lot about them because of the antenna on my truck. And they emphasize "friendly" and "inexpensive" entertainment. Hamfests are friendly, but they are expensive and tend to be overwhelming to the newcomer. Even *73* tends to err slightly in this direction ... those ads for gear have terrific price tags. The equipment is probably worth it, but even a kit sends too many potential hams racing back to their CBs. Let's face it: To a guy with a non-working spouse and 2 or (ugh!) more children, $400 to $700 for a transceiver is frightening. And then there's all that "other equipment." We need more articles on good quality stuff that a person could put together "as the money becomes available." Besides, those how-to articles and the attitude that goes with them are among the best selling points of amateur radio.

Well, enough haranguing. As someone who intends to get my Advanced ham ticket soon, I have a vested interest in seeing to it that there will be plenty of space in which to "do my thing" after all that effort. Besides, knowledge should be used and passed on – and our fund of it expanded. We can't do that without getting more people involved in hamming.

Thanks for the forum.

Carol G. Sakowski
Mt. Horeb WI

So what ham can afford a non-working wife? – Wayne.

NAVASSA, AGAIN

Would you please publish the QSL address for YBØABV, as via KØDX/4, 11104 Seaglade Drive, Pensacola FL 32507. QSLs for 1971 WØEXD/KC4 Navassa Island operation should go to the same address.

Dr. Richard J. Brown KØDX
Pensacola FL

300 MILE ATV!

On Oct. 3, three Ohio stations, WA8RMC, WA9ZIG/8, and W8DMR, received standard scan pictures from W9ZIH. Bill W8DMR, Columbus OH, estimates the path to Ron W9ZIH, Hickory Hills IL, to be 300 miles. Ron runs 500 W to 4-24 el. yagi array. Bill runs 50 W to a 48 el. collinear array at 40 feet. Art, Dale and Bill report that this ATV contact may be a new record.

Bill Parker W8DMR
Columbus OH

HITCH A RIDE

The letter from John Halliwell prompted this writing. As I read it my mind wandered back the 20+ years to the days when I was trying to first grasp electronics. Remember "CARL & JERRY" and the CK722 (I still have my first one).

To all young electronics enthusiasts, may I suggest they contact a local ham (hang around a Radio Shack, hams are in and out all day) and hitch a ride to a hamfest where ham and electronics magazines can often be found for less than a dime each, then READ READ READ! It's amazing how the pieces will fall into place.

How many times have you seen a young person with a parts list being given a hard time by some power-crazed clerk? I am slow to anger, but this enrages me. I jump all over the clerk with both feet and have ended up donating parts from my junk box. Next time you see this happening, remember when you were young. Jump in and reach out – it feels great!

Richard Wright
Tiffin OH

DARTS AND LAURELS

First the praise: *73* is a fantastic magazine. Between myself and my friends, we get about all the popular ham radio magazines currently being published and we all agree that *73* is TOPS. The ratio of technical articles to ads is excellent and the class of those articles is also very good. Your policy in allowing only reputable firms to advertise in *73* is also much appreciated; I have purchased several items from firms listed and can only say that I have had the best of service.

Now the criticism: Judging by the fact that in almost every country that I have visited (I am in the airline business), *73* can be found on newsstands throughout the world, it can be assumed that you have a substantial export mailing list and it is on behalf of your many overseas readers that I make these points.

1. We can do without the "historical interest" stuff – by this I mean that, due to the time factor involved in mailing to countries out of the USA, some of the data and ads are of historical interest only by the time the magazine reaches the subscriber. Propagation charts and some ads which offer Specials valid during the month of publication only are examples of what I mean. While it is realized that the great majority of your readers are in the US, please give a thought to those keen readers in the far-flung outposts of the empire who, after all, do pay the same money in subs and who would certainly appreciate this consideration.

2. These new-fangled names, and especially the abbreviations, for the latest generation of ICs are most confusing to the casual reader. Would

it not be possible to include an abbreviation list so that we can decipher Naked RAMs, ROMs, PROMs, MOS, CMOS, AND, NAND and the suchlike? Street names and signs are for people who *don't* know the way!! A permanent abbreviation list and perhaps explanatory notes would be most helpful.

Thanks for a really great magazine; may your shadow never diminish.

Rob McGrath ZL1BFF
Auckland, New Zealand

Advertisers, please note! — Wayne.

USE IT OR LOSE IT

I have just tonight had the opportunity to speak with FCC Chairman Richard E. Wiley on a listener-response radio program aired over KRLD-AM in Dallas. The two hour program included Chairman Wiley, Commissioner Benjamin L. Hooks, and several FCC bureau chiefs. After a wide-ranging interview and discussion of broadcasting policies, political fairness considerations, and CB problems, telephone lines were opened for listeners to call in and discuss any subject with these FCC executives. Though several questions touched upon amateur radio and CB expansion, I believe I was the only ham to call in and confront the Commission representatives with what I consider an important, and so far unresolved, question in the minds of radio amateurs: the potential loss of spectrum now allocated to the amateur service for the provision of a "citizen's band" available to auto makers and radio manufacturers, so that they may sell to a new market factory option two-way radios in new automobiles.

The following is a literal transcript (from my tape recording of the broadcast) of my question and the Chairman's reply . . .

WA5RON: "Good evening, gentlemen. I am a radio amateur calling from Austin, Texas, and I wanted to ask Chairman Wiley about rumors and allegations we've been hearing for about three years now that major automobile manufacturers and other electronic industries and associations thereof have been putting pressure on the FCC through the Office of Telecommunications Policy, and perhaps the White House itself, to take away from radio amateurs certain frequencies, particularly in the 220 to 225 MHz band, to provide a Citizen's Band, a new Citizen's Band for them, so that auto manufacturers can install factory two-way radios in automobiles. I wonder if Chairman Wiley could assure the radio amateurs tonight that frequencies will not be taken from their service to provide this new Citizen's Band."

FCC Chairman Richard E. Wiley: "Well, the Commission hasn't made a final decision on that. Let me say that there are a lot of problems in the 224-225 band, technical problems as well as policy questions, and I have some personal reservations and doubts that we will ever make that decision, but the Commission has not yet made a final determination in this regard. I happen to think the next expansion of CB might well be at 900 MHz, but that's a decision down the, down the trail a bit."

I thought that you would be interested, as I am, in the FCC's current thought over the "224-225 band" proposal, and the possible pressures that are being brought to bear on this question. I feel somewhat heartened by Chairman Wiley's apparent personal resistance to re-allocate these amateur frequencies, but I wish that he had denied outright the rumors of strong political and industrial lobby pressures that I alluded to. I would feel so much better about our chances to preserve our amateur frequencies.

J. R. Johnson WA5RON
Austin TX

DX TKS

Greetings to all at *73 Magazine*. Keep the good work going, it is the day of the month when *73* arrives. Please ask your advertisers to mention if they sell overseas. Hi.

S. K. Mogensen OZ6SM
Aabybro, Denmark

KEEPING UP

I want to report outstanding service from one of your advertisers — James Electronics, 1021 Howard Avenue, San Carlos CA 94070.

Please keep the digital stuff rolling. I didn't like it, but have realized it is a necessity, especially as I do some TV repair and new sets use more and more. If I don't keep up, using *73*, I might as well retire. Thanks for the best mag in the field.

John P. Dieringer W6RVP
Los Angeles CA

Here, here. — Wayne.

ROLLING BILLBOARD

I thought I would drop you a picture of my second hobby. My rolling billboard is actually a 1961 Chrysler. The idea for the message came from you and your mag. The parking lot at the local asphalt oval looks like a 27 MHz antenna farm. I would say I have a pretty good "radio" audience.

I was going to run some 2m mobile on the track, but it gets awful crowded and everyone seems to be in such a hurry. Besides, the QRM is terrible!

Shown in the pic is my body (still in one piece), my trophy (amateur division), and my checkered flag. It is one of many wins (actually it's one of three).

The old asphalt oval is a lot of fun. I get into a lot of DX pileups on the ham gear on Saturdays and a lot of retaining wall (and misc. autos) on Sunday. I've never been hurt on the track, but I have gone through a few pair of skivvies.

Oh well, the racing is over for this weekend and this year. The "billboard" is safely tucked away until next year. I guess till then it's DX pileups all weekend. Ham radio is my #1 hobby: Richard Petty, eat your heart out.

Richard A. Zidonis WB8VBS
Cleveland OH

13 DOWN, 21 TO GO

I just thought you would like to know that your code tapes are just great. I started with the six wpm, and had it down pat in about three weeks. Then I bought the thirteen wpm tape and in about one month I just could not copy it. I just couldn't get past the ten wpm hump. Then I bought the 21 wpm tape.

I drive around a lot and I took the tape with me. Instead of listening to the radio, I listened to that tape. About 3 weeks later I had the 13 wpm tape down pat. I have been listening to the 21 wpm tape every time I get a chance. I can almost copy it perfectly, but every once in a while I hit a bump, especially on the Zs, 6s and 4s, as they sound so much like 7s, Bs and Vs. Hi, hi!

I would like to know if you make or have a 25 wpm tape; if so, I would like to get one. I know if I listen to it, I will get the 21 wpm tape down pat.

My way of thinking is, if you can't copy 13 wpm, go to a 21 wpm tape.

I got my Novice call on May 18, 1976, in less than *five* months, and your tapes have helped me so much I wanted to let you know about it.

Frederick J. Feddersen WN1YDC
Londonderry NH

Sure, Fred, we have a 25 wpm tape, $3.95 postpaid. Have fun. — Wayne.

CQ DX, CQ DX

Please pass this information to all DXers.

We are once again on the YASME trail. This time our Worldwide YASME DXpedition is literally following in the footsteps of Danny Weil, the first radio amateur in the world to go forth on a sustained full-time DXpedition.

Like Danny, we are starting this episode of our DXpedition from the American Virgin Islands and under the guidance and help of Dick Spenceley KV4AA. Dick, who is now 71 years old, spends several hours on the air every day. Dick and his wife, Anna, are both very active and look and act much the same as they did when we visited the Virgin Islands 20 years ago.

We will remain here one month, operate all bands, phone and CW, signing W6KG/AJ3.

From here we plan to visit and operate from *all* nine of the VP countries. Watch for us and work us, but only one QSO per band per mode please.

Lloyd Colvin W6KG
Iris Colvin W6QL
American Virgin Islands

I'm jealous as all heck. — Wayne.

SYMPATHY

After reading WB8SWD's letter and your response in November's *73*, I could not resist getting into the act.

As one who has been an active amateur for almost 25 years, and who has been a close and concerned observer of the amateur scene even longer, I cannot but sympathize with OM Torossian's view.

What we really need is not large numbers of new licensees but more efficient frequency utilization by those presently licensed. I realize, of course, that getting amateurs to make more logical and effective use of the

amateur bands is probably a lost cause, but feel it worth the effort to try, rather than expend our energies recruiting more licensees who will probably follow the example of their peers and cluster in the same spots, compounding the problem instead of solving it.

And why must all newcomers "come into amateur radio via the lowband $800 transceiver route"? With home brew or kit-based equipment, a person can get started in amateur radio for a helluva lot less than $800.

There are no easy solutions, but let's spend a little time and effort solving our present problems rather than rushing to create new ones.

Morgan W. Godwin W4WFL
New York NY

Trying to start a new trend, Morgan? – Wayne.

STILL WAITING

I just thought I would let you know that *73* is the *best* amateur radio magazine in the world! Yes – the *world!* I've had them from all over: Australia, U.K., Germany, U.S.A., Hong Kong. None comes close to *73*.

The mail from Peterborough is good, too. I got May's issue in May, July's issue in July, and September's in September. I'm still waiting for June's issue of *QST*, and July's, and August's, etc.

Keep up the good work, and you can put my name on the list for the next 3 years.

Baden J. Melhuish ZL3THO
Christchurch, New Zealand

IMPRESSED

I have just received your November issue of *73* and wanted to say I was very impressed with it. Your articles on different computer and IC projects are very helpful to me as a beginner. Yours is the first magazine I have read that has a full catalog for another company. With that and your limit of just a few pages instead of half a book on the contest winners, I think I will have good reading for the next three years. Keep up the good work.

Les Sullins WBØKFK
Kansas City KS

BE CAREFUL

The audio of the TR2200A can be improved by a field modification – two 1/16 inch holes drilled in the back of the microphone.

I recommend that you take the back off the mike and drill the holes just above the "n" and "m" in the word "Dynamic," and then reset audio gain and deviation for a vastly improved radio.

Circuit boards, schematic diagrams, beautiful photos, and detailed instructions are not available. Just be careful – the microphone element itself does not need two 1/16th inch holes! Only the back of the case!

I enjoy reading your magazine.

Robert Behar WA4HCI
Columbus GA

Holy mike-ral. – Wayne.

DRAKE SCORES

What with all the publicity about the rip-offs by Trigger Electronics, I thought I would add my bit about a company that offers excellent service after the sale – R. L. Drake. I had occasion to utilize their service on my T4XC, which had developed a recurring problem with the balanced modulator, and I would like to reassure your readers that R. L. Drake Company certainly stands behind their products and really practices excellent customer service relations. Mr. Bill Frost of the Drake Service Department was most helpful and cooperative. I find it quite refreshing to find this attitude in a company in this day and age.

Mark Witmer WA6FXM/9
Great Lakes IL

THE VLF CAPER

I (and others) would like to see an article or two in *73* on construction of simple VLF (very low frequency) antennas and receivers or converters. And what, exactly, is propagation like at VLF? Believe it or not, it is very difficult to find anything on this subject, although I've found a few incomplete hints here and there. I'm certain that many *73* readers would be interested, provided they would be told as much as possible about the interesting, weird, secret and sometimes totally inexplicable things going on down at VLF.

It is theoretically and in fact possible to radiate any frequency above zero Hz as rf and to receive it – no matter how low. During WW II the sly Germans wrapped a one turn loop antenna *around a mountain* and keyed the 50 Hz power line into it through a transformer to send secret CW messages! This was transmitted as rf, not merely hum. It was quite some time before our agents learned of this, because almost no one (except the Germans!) had receivers capable of tuning down that low. The mountain happened to contain magnetic ores which improved the system gain.

Large VLF antennas can operate quite efficiently when buried and thus *invisible* (how many don't we see?).

Now the US government is equipped with VLF receivers and transmitters for certain special (and often secret) purposes. The Navy recently began using the 30-300 Hz band for communication with its submarines, as this band penetrates water quite well. The Navy also uses other VLF bands. (And I meant 30-300 Hz, not kHz.)

A few years ago a US secret (CIA) agent was caught in Cuba sending secret messages by a complete VLF outfit in a briefcase. Obviously, these frequencies are still considered "safe" because of the general lack of VLF receivers.

Various natural objects in space occasionally generate weird VLF signals that sound like the sound track of a science fiction movie. Lightning also generates weird VLF signals, and the mechanism isn't completely understood.

WWV has an experimental outlet at 19 kHz and a permanent one at 60 kHz. Complex and comprehensive time codes are sent digitally, which should interest computer freaks. VLF is more reliable and provides higher accuracy than is possible with WWV's other frequencies.

Perhaps you have read some of John A. Keel's books and articles on UFOs and other paranormal phenomena. Keel knows one or two hams who have ancient WW *One* receivers capable of tuning down to about 3 kHz. Keel doesn't say if tubes (audions) were used in these particular receivers. However, tubes did exist during WW I, though they were very new. VLF was used extensively during the early days of radio communications. Some transmitters used mechanical ac generators putting out rf at below 100 kHz. This was not a spark gap system.

The fortunate hams with these ancient VLF receivers have received and recorded voice transmissions speaking no known Earth language! They are not Earth languages in code or Earth-language sounds in code. Occasionally it sounds like dogs barking to each other, but usually it is a definite but unidentifiable language. Expert linguists have listened to the tapes and have been unable to identify the languages used. Keel suspects that these transmissions are precisely what they appear to be – unearthly – that these are UFO communications, that the UFO entities know that we have very few VLF receivers.

Maybe our government knows much, much more about UFOs than they admit.

Designing a reasonably simple but reasonably sensitive and selective VLF antenna and receiver or converter would not be without problems. For example, it would be difficult to physically realize the tuning circuits with standard, readily available components. The coils would require far more inductance than is usually used in receivers and converters. (Early receivers often had huge coils.) This problem wouldn't be so bad if you want a single frequency receiver or converter, but I want one capable of covering the whole VLF range, so that I could tune around and perhaps discover something interesting. Neither would standard tuning capacitors be optimum for VLF. The solution might lie in one of the new techniques to synthesize inductance or capacitance.

Clyde E. Wade, Jr.
Little Rock AR

Sounds like a bunch of bat guano to me, Wade. And as far as tuning in audio frequencies is concerned, it doesn't take huge coils, only some audio transformers. Once you've received the audio signals from an antenna, they are audio signals. If you transmit them by ether via an antenna, then they travel at the speed of light . . . if you put them in a loudspeaker, they travel at the speed of sound. If you detect the sound waves, you get audio . . . and if you detect radio waves at audio frequencies, it should be audio. Is there something I don't understand? – Wayne.

HATS OFF!

Just a short note to let you know I appreciate and am wholly in favor of your attitude towards your advertisers. I'm particularly in favor of having your readers applaud the specially good ones.

In that category, here's some applause for Tufts. I recently made a couple of crystal orders to them, which were both delivered with what I considered amazing speed. On the second order I had a crystal which wouldn't net quite right so I returned it to them. I mailed it back from Arizona on a Monday and was absolutely amazed to have the replacement crystal back in the Thursday mail. My hat is off to Tufts – they have one satisfied customer.

Bill Hosking W7JSW
Scottsdale AZ

WARBLE, WARBLE

You can put Bullet Electronics back on your list of great people. Apparently the biggest problem I had with them was due to the mail system, as I got a refund check and a Warble Alarm for all the problems. It turns out they were out of stock on the product I ordered. Enclosed is a subscription request for *Kilobaud Magazine.*

Martin Peck WBØJMO/KG6
Guam

What do you do with a Warble Alarm on Guam? – Wayne.

COUNT YOUR BLESSINGS

Thought you might like to know what amateur radio in Okinawa, Japan, is like. I can speak only for American hams who are servicemen and women stationed here, but our brothers and sisters in the states have

Continued on page 140

Another* *Christmas present* for you

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**THIS OFFER GOOD FROM NOV. 1 THRU DEC. 31, '76*

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Those of you who happened to read my special article on total coordinated band planning last June may remember that I stated therein something to the effect that the multi-mode VHF transceiver would have a rather large effect on the operating habits of many an amateur. This innovation would not only put a bit of diversity into the aforementioned "operating habits," but would also call for a revision in our thinking in matters of VHF coordination so as to protect the integrity of all VHF special interests, not just VHF repeaters. Perhaps a better term than coordination would be band planning, total voluntary band planning from within the amateur community.

While the mail response to this article was about evenly divided, it seems that the greatest flack was received from "repeater people," both owners and users who felt that while coordination was important for their mode, the same did not hold true for other modes. On the surface, and most importantly by today's operating standards, a good part of their reasoning may hold merit. The opponents cite the fact that repeaters are coordinated to specific channel pairs, while other modes have the ability of a VFO to scamper about the band. Fine, but what these repeater people fail to understand (due mainly, I suspect, to lack of knowledge on the way these other modes operate) is that in many areas SSB is beginning to channelize itself in a similar way to the way FM and FM repeaters channelize. If you are involved in VHF modes other than FM, you will probably understand what I mean by "protected calling channels," "DX monitoring channels," "local rag chew channels," etc. In different parts of the country the terminology differs, but the object remains the same: the setting aside of specific frequencies, mainly on two meters around 145 MHz, for a given specific use on a gentleman's agreement basis. Does all this sound a lot like both channelization and coordination? Are the similarities now a bit more evident?

I suspect that as more amateurs get their hands on these little gems, some form of "coordination" will take place, whether it's national in nature or just on a local level. However, we have a rather special opportunity right now, an opportunity to get those lines of communication built and to work together on a level not limited to the coverage area of our favorite repeater. We have an opportunity to plan for the future in a manner not normally within our reach. Getting to know one another on a local level is the first step, learning a bit about the other guy's favorite mode of operation is the second, and learning to interact with one another is by far the most important.

Call it band planning, coordination or what have you. For each mode and each special interest to assure itself of longevity and viability, "coordination" on some level will happen. Wouldn't it be nice, though, if we all got our act together and were the same nationally? To that small minority of "FM repeaters only" people who seem critical of the ideas of others, remember that those band planning other modes learned their act from what you have accomplished. You were the ones who succeeded in doing the impossible when virtually everyone thought it could not be done. You provided the leadership for yourselves, and whether you realize it or not, you seem to have done so for others. Your obligation is clear: to offer guidance to others when they request it, regardless of what mode they may operate. It's the unwritten obligation of the brotherhood upon which amateur radio is built. It's also part of the challenge of amateur radio's future, and the official statistics seem to tell us that we're growing in number. Amateur radio going public through a rather well-coordinated public relations effort seems to have turned the tide. This means more amateurs and this in turn means more individuals involved in each mode. To VHF and UHF this means more repeater operators, more repeaters, more RTTY, SSB and probably even more AM among other modes. Even more ATV. Each group will indeed need spectrum and, by carefully planning now, we can make sure that it's there in the future. Think about it!

Among the attendees was KTLA-TV personality Johnny Grant WA6MJV, here being greeted by Jim Pendershot WA6VQP of the SCRA.

While on the topic of modes other than FM, and specifically speaking about two meter SSB operation, let me introduce you to a rather interesting group out of Fort Worth, Texas known as "Side Winders on Two" or, as they call themselves, simply "SWOT." Len Hoops W5JTA, SWOT Secretary, was kind enough to send me a press release about the DX accomplishments of his group and also put "LW" on their newsletter mailing list.

More about the DX in a moment, but first a bit about the group itself. These are a group of amateurs interested in seeing what can be accomplished without the use of a radio relay device on the two meter band: to see how far one can talk using other modes and operating procedures that can't be found on FM repeaters. They see this as an exciting challenge to their individual and collective skill, and this summer the perseverance of a number of their members paid off. On July 29, 1976, four of their number had the opportunity to make DX contact with a number of California stations. On the Texas end there were WB5MEV, WB5NLB, WB5ACO and Len W5JTA. The stations that they worked were WA6OOC, WB6HDB and WA6DVX in LA, as well as W6DPD in Fresno. In addition, the report continues that another SWOT member, WA5SMA, in Vernon, Texas also QSOed with WB6HDB, and K5UGM while mobile near San Antonio also worked a 6-lander. Bill Brady WB6HDB happens to be a friend of mine, and when I caught him on one of our local FM systems, confirmed his contacts.

In a rather beautiful letter from Len at a later date, he gives credit to the advent of the multi-mode VHF transceiver for providing more diversity to his operating habits and giving him the chance to get involved in SSB and two meter DX chasing. I have said many times before that a whole different world exists below 146 MHz and SWOT is another example of this. Just tune down there, or to six, or to the low end of 420 to see for yourself. Now ... part two of K3BNS in Los Angeles.

Even "Looking West" got its chance now and then to pose a few questions to John. Among them was one that I feel is rather important, because in my opinion John's answer gives a bit of a hint as to what future reports on restructuring and deregulation might hold and, moreover, who will help him in formulating same.

My question was as follows: "10 meter repeaters are now legal; crossband repeaters are legal; Technician class operators are coming out on 10 meters. Is anything going to be done about this and where does a Technician class operator sit if he happens to be on a repeater that is being repeated to 10?"

John's response was this: "We have an outstanding decision to make on 20282. You know that was very carefully labeled 'First Report and Order' (virtually everyone in attendance laughs at this comment) and that business of the 10 meters would solve a problem if we went ahead as proposed. (I must assume that this is a reference back to my question as asked and the content therein.) But I think there is another issue we've been kind of waiting to hear people start talking about, and that's with this newest change and the new structure we have, which I guess everybody's reasonably happy with. The only difference now between Technician and General is that code test ... telegraphy ... that's the only difference in the requirements. So what should be the difference in privileges? The communications act says that the FCC is responsible for establishing qualifications for radio operators and making sure the license (possibly licensee ... a case of tape drop-out muffled one word here) and the qualifications as established are consistent with the duties they have to perform."

Questioningly John continues: "Maybe they should be given all the General phone frequencies ...? We thought that might be something that amateurs might want to cogitate."

Now back to some questions posed by others present: "There have been some bills in the Communications Sub-Committee (referring to Congress); one in particular is there right now about forcing the entertainment (electronic) industry to improve their designs so that they wouldn't be so subject to interference. I understand that the Commission has been asked a number of times in the past to present an opinion on these bills, either pro or con, and they failed to do so, and this has happened now for a couple of years. Do you know what's happening now on that?"

John: "Yes, they're waiting for the Congress to ask them what it is; they've been asked by everybody other than Congress, and it would be inappropriate or presumptive to comment on anything that is still in sub-committee. The Commission has not taken a position; I've heard it discussed both ways. The problem of susceptibility goes far beyond just television receivers and radio receivers and so forth. You know we have some unplanned receivers; I'm sure you've heard the stories about the public address systems, organs and stereo amplifiers in churches that pick up

some things at inappropriate times. Whether the Federal Government should be getting into regulatory matters to that detail in the present climate – well, I am sure you appreciate how that might be."

Question (same questioner pursuing the point): "Well, with all the RFI complaints I am sure are down at the office there in Washington, it would seem it would present a pretty good argument in favor of some more regulation on the (electronic) entertainment industry; at least someone should be made aware that this is available for Congress to look at."

John: "There would have to be a great deal of funds, of course, to make that system work. Our labs would have to be enlarged, for instance, and the staff enlarged, and standards set on all this equipment; they would have to be brought into the labs to make sure they meet all these standards and it sort of elevates that whole area maybe beyond what a lot of people think it should be; that's where the dilemma occurs."

For some reason, the subject of CB radio and the CB service was on many minds. A number of questions were asked about CB and CB expansion. Among them was this one: "I've read in the newspapers that 40 more CB channels (note the questioner's error in stating 40 more rather than 17 more for a total of 40) are being opened as of the first of next year. In view of the well-publicized chaotic conditions which have prevailed on the CB bands, and the amounts of illegal activity and the inability of the regulatory agencies to control this, what is the reason for giving CB even more channels than they have now. Can you answer that, please?"

John (his answer very concise and to the point): "Yes, that's what the public wanted and of course the Commission is there to serve the public."

Question: "Back on the subject of licenses: For instance, you have a mail-order license. As of the 23rd of July, you have grandfathered all Conditional Technicians to be as normal Technicians, is that right?" John responds affirmatively and questioner continues: "Since you are already a Technician, you've passed 5 wpm; do you have to retake the written examination when you go in front of the FCC examiner for your General?"

John: "No, you just come in and take your 13 wpm and then you get the General." Questioner thanks John and then John kiddingly adds: "Hope to see you there shortly." This brings a chuckle from the crowd and John continues: "I think we have come more than halfway; I think you ought to come a little bit too. The Techs I've talked to have all expressed their desire to move forward."

Question: "John, I'd like to compliment you on getting that Technician and Novice thing together; you know, the idea that the Technician now can also use code. I think we're all anticipating when the second shoe will drop with regard to the other things that are in the cooker. Do you have any idea when we'll be getting some further information on some of the other proposals that have actually been sent forth?"

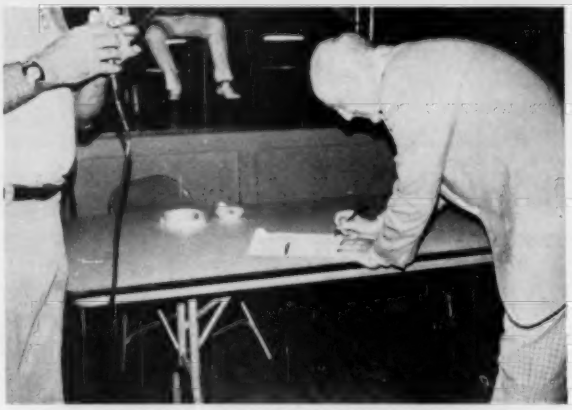
John: "Yes, you know we got that through. I had to literally stand up in front of the Commission and swear that absolutely nobody would be unhappy with those changes we made and I think that my credibility is still good, so maybe we can move on to some additional things. One I get asked about a lot is the additional phone privileges for Technicians; I think there are some sub-bands in there we propose to eliminate, maybe move down to HF and so forth. I know that all the Techs are interested in that, but I don't see all the hurry. I really think the Techs have made out pretty good in this; it's even easier to move up to General and so forth. I'm sure we don't want to have everybody take the Novice license, move on to Tech and then just stop. We want to leave a little bit of reason to move on up."

One particular questioner became involved in a rather interesting two-way Q&A period with John on the subject of willful and malicious jamming and what could be done by both amateurs and the Commission. Earlier, during the seminar, John had described working with the local FCC engineer in charge as a starting point, but the information garnered from this particular Q&A sub-section is particularly interesting. Here is part of it:

Questioner: "Many of your local police agencies have reserve programs; you have reserve officers and deputies. Is it conceivable, since you are a regulatory agency, to appoint Field Engineers (I assume that the questioner refers to appointment on a voluntary non-remunerative basis), either electronic engineers with many years amateur experience or perhaps people in the Department of Justice who can prosecute, or sworn officers of local police agencies who are also amateurs? Is there any such thing possible?"

John: "I don't know. That was brought up by several police officers on occasion to me and I've checked it out with our attorneys and they're not quite sure if the 'Act' does permit that or not. We've also thought about the creation of, for lack of a better term, the FCC Auxiliary. For instance, if we could set up a good system for giving examinations, then the field people wouldn't have to tie up the manpower; about half the manpower is tied up in giving examinations and answering questions for the public and so forth. That money could be reprogrammed toward straight hard enforcement work.

"I have heard the Chief of the Enforcement Bureau talk about this and ask what it would take: FCC, just tell us, how much would it take to clean out all of it? (I suspect this means all violators in both CB and amateur services). That's sort of a staggering thought. Maybe that's not the way to do it. The best example I can think of is how amateurs do it; it's got to be a self-enforcement system if it's ever going to work. If you can't get people to realize that this is for their own benefit, then you can write all the rules you want, you can put all the policemen out there you want, and it's still not going to work. There are still going to be those bananas who cause trouble; and get on our repeaters and act out the writing on the wall's graffiti and all this other junk they do these days. So they are looking at other ways, particularly in CB, to try to convince them of more self-enforcement; they point at the amateur service as one example of how this works.



The S.F. Valley A.R.C. honored John by awarding him "honorary membership." Here John places his "Hancock" on the bottom line to accept this honor.

"One of the things they (I suspect this refers to questions asked by CBers) ask is 'What can we do?' Well, I think a lot of it has to do with the callsign. In the CB service it sort of grew up that you didn't use your callsign. You didn't identify to the world who you were. You became some mysterious stranger. You were anonymous and this raised the inclination to make mischief. Now, that has never prevailed in the amateur service. Amateurs have always been extremely proud of their callsigns and we probably do more arguing with amateurs about callsigns then any other thing. They're very, very proud; they listen to the 10 minute identification rule; some guys give their callsign 10 times in one minute (chuckle from the audience). And when you have a situation like that, where people are saying who they are and they're willing to stand up and identify themselves, they behave themselves. They're responsible people. And that's one of the things we always try to point out to the CBers: use their callsigns."

Questioner interrupts John and asks: "I would agree with you that amateurs don't want to be over-regulated; I probably could speak for everybody in the room for that. As you very well know, it doesn't take an amateur license to steal an amateur radio; they look in the car just like those other radios. (John interjects the fact that his two meter radio had been purloined, then questioner continues.) They also got mine once, but the point is, that once he has got it and he can't sell it, he plays with it. This is mushrooming. The callsign means nothing; you have people who are amateurs, qualified for their license, who don't know enough not to talk to that individual and they create ten times the problem that would normally be."

John asks: "Is that really right? We've had that problem in our area and in just about every case the amateurs have been able to solve it."

Questioner continues: "We have a problem here in the Los Angeles area; it's been going on about 3 to 4 weeks now with two particular individuals who jump from frequency to frequency. We are just now, because of this situation, organizing a cross-frequency coordination which should have been done a long time ago. The problem is getting severe, in that the amateurs are adding to it with their own illegal comments." (Note: For those among you who are unaware, it is a direct and major violation of the rules and regulations to enter into QSO with or converse via the radio with a non-licensed/non-identified station.)

John interjects emphatically: "That does not work!"

Questioner: "Yes, but it's being done!"

John: "That's what they want; they want attention. If you let them do it; they'll just keep doing it." (Note: Remember that I have written in the past about never giving *any form* of recognition to one who willfully plays havoc with you on your favorite repeater? Ignore them; T-Hunt them down, what have you. But again – no matter how much it hurts, *never give recognition and thereby an audience to a jammer – never.*)

Questioner: "If we can't solve the problem, it will grow."

Continued on page 132

BE MY GUEST

visiting views from around the globe

In Pursuit of the HFers

Here at *73* we receive dozens of ham club bulletins and other publications each month. One of the newer ones we're getting is called *SSB News*, published in Daytona Beach FL. It's not for hams operating SSB . . . the 20 page magazine is aimed at people running SSB (and kWs) between the CB band and 10 meter amateur band.

SSB News is filled with advertising (ham transceivers, linear amplifiers) and advice to the so-called "HFers." "Your signals are heard in foreign countries . . . and when a ham reports a violation . . . heads will roll and tails will be busted!" warns an article entitled "Trouble Ahead." The author goes on to urge HFers to stick to the decision of the HF Regional Advisors meeting at Colorado Springs . . . that all HFers use 27.425 MHz and 27.325 MHz as calling frequencies, with 27.315 to 27.585 MHz set as the "HF band." There's even a VHFers organization, with calls and numbers . . . but, of course, no last names.

What does the FCC think of all this? Richard Smith, Chief of FCC's Field Operations Bureau (FOB), put it this way: "I've been given the task of stopping the Atlantic Ocean from reaching the beach; I've been assigned one man with a broom . . . and he's sweeping as fast as he can." Smith says FOB has 4 teams of agents, five men to a team. That's twenty agents against more than 30 thousand illegal SSB HFers! What's more, the FOB now has *less* personnel than it did 28 years ago, before the communications boom!

Despite the odds, FOB has managed to make arrests and get convictions from federal judges. According to Smith, recent operations in Birmingham AL, Newark NJ, and Des Moines IA have nailed 23 HFers with fines and confiscated equipment in the thousands of dollars. As you read this, FOB agents, US marshals and federal search warrants are coming down on another group of illegal SSB operators. (More on the latest raids coming up.)

The FCC is concentrating on individual users, hoping to prosecute enough of the HFers to discourage growth of outlaw SSB. Normal practice is to send an FOB team into an area, monitor for several nights, and pick out the worst of the bunch. Then the agents visit a local federal judge, obtain search warrants and US marshals, and make their raids about a week after setting up.

As Smith put it in our *73* interview, "We don't expect to ever have the resources to put a cop on every beat . . . a monitoring van in every city . . . but we do plan to use education and voluntary compliance along with the federal courts when necessary." Education and peer pressure turn out to be the FCC's best weapons, due to the extreme shortage of enforcement staff. Smith admits he is hard pressed, and agrees FCC can only concentrate on the "hard core" HFers, CBers and amateurs.

The amateur service has not been a major problem, according to Smith. Deliberate interference is probably the biggest amateur hang-up, with extreme difficulties in proving cases in court. Smith says FOB monitoring vans have spent weeks listening to suspected amateurs, only to come up empty-handed. The agents must be able to prove where the transmissions came from in a court of law. That takes what Smith calls "close-in monitoring," and the record shows it's been a pretty hit or miss operation. (During the WESTCARS mess, several stations were "close-in monitored" for weeks, with only one license revocation resulting, and that violation was not directly related to the net interference problem!)

Net interference poses a special dilemma. Smith says there are really two sides to the story. The net feels that they have more right to the frequency, even in non-emergency situations, while the interfering stations view the net as an unofficial theft of frequency. Smith says it's a ticklish situation, which has to do with the nature of net operations and the difficulty of proving interference complaints. "Amateurs as a group must put their heads together and deal with it," says Smith, who admitted he did not have a solution. (Smith himself is an amateur.)

What can the amateur do about net interference and the HF bootleggers? Apparently not much. Despite published reports that amateurs played a role in the New Jersey busts, Smith says reports from hams can only provide an indication of the extent of illegal activity. Actual "close-in monitoring" is the only answer in Smith's view, although FCC is not about to turn down ham help. To the contrary, they are interested in *any* information they can get. The key is self-policing, and field enforcement against the "hard core" violator. Fortunately the amateur service has not required the kind of effort FCC is mounting against the HFers.

Incidentally, anyone wondering how the monitoring stations are going to tell Novices from the rest, now that WN calls are no more, can be assured FCC knows . . . each monitoring station has direct 24 hour access to the Gettysburg computer.

Warren Elly WA1GUD/1
Associate Editor

The 75m Follies

It's getting so that I am almost ashamed to tune across 75 meters in the evenings when demonstrating ham radio to a visitor. In case you weren't aware of it, there seems to be a group of individuals down there who feel they must use amateur radio as a platform to spew forth their personal political and sociological ideals, while using the guise of an "amateur net" as a cover.

I am even more angered by the "Priscilla Goodbody" brand of ham, who feels it is his duty to uphold "motherhood and apple pie" by bending the law to his own means, and using his station to jam and harass the others. Frankly, I find the jammer even more disgusting than the rhetorician.

How, then, do you handle such a situation? First, we must realize that whether we like what is being said or not, there are laws that must be obeyed to protect all of us. We might not like what they are saying, but they are apparently operating within the limitations of their licenses and therefore are legal.

There is a rather simple and obvious solution, one we have seen work on VHF repeaters time and time again. Obviously, for these people to keep it up night after night, they must assume that they have an audience. Thus, the attention rendered in the form of malicious jamming is like a "Linus security blanket." As long as there is jamming, the aforementioned hams will know that there are people listening, and will do their best to entertain the audience.

Take away the audience, and what do they have other than each other? Nothing . . . no reason at all to exist. Many repeater systems now instruct their users to ignore and boycott jammers. Why not apply the same logic to the 75 meter problem? We should exert peer pressure and create a no-hams-land at least 10 kHz either side of them . . . give them a clear berth to spew forth their rhetoric and hope that in doing so one of them will make a slip and give the FCC monitoring facilities what they need to handle the matter.

Remember, no one is perfect, and though it may take some time, they eventually will make that slip. In the interim, the best thing we can do is make sure the rest of the world is made aware these people do not in any way reflect the feelings of the vast majority, and indeed that they in no way represent the true scope of interest and values held by American hams. If there is one tragic aspect, it is that those involved are amateurs. Both the rhetoric peddlers and jammers are the kind that will hurt us at the 1979 WARC, the kind of harm that might well spell an end to ham radio as we have all come to know and love it. We all agree that a way must be found to stop them, and taking away their audience, their very reason to exist, is the best alternative. It's in your hands.

Bill Pasternak WA6ITF
Panorama City CA

Stealing and Dealing

In Los Angeles the emphasis may soon be shifting from counterfeiting to grand larceny and dealing in stolen merchandise, as the investigation of crime in the electronics industry mounts. The Los Angeles County District Attorney's office, already heavily involved in checking the affairs of Pacific Semiconductor in Inglewood, has launched a separate probe into the theft of computer circuit boards valued at 8.7 million dollars from Xerox Corp., El Segundo. Other electronics companies, particularly in northern and southern California, are expected to aid in the investigation by revealing previously suppressed burglary information.

Early information indicates that US electronics companies have been plagued for the last five years by unsolved "inside jobs," many of which have been carefully shielded from publicity by the companies involved.

Although the investigation of possible crimes committed at Pacific is focusing on counterfeiting, a diary kept by private investigator Gary Williams also contains references to the marketing of stolen goods. Undercover agent Williams was hired by Fairchild, Intel, Motorola, and National to infiltrate Pacific. (Signetics joined the group later.)

Williams started work on March 3. He delivered approximately 120 pages of commentary on the PSI operation to Robert Ewen, an investigator for the LA County District Attorney's office, on May 25. (Ewen has also been assigned to the Xerox case.) Search warrants were issued and PSI and two related companies were raided on June 3-4. According to Mitchell Harris, Deputy District Attorney for major frauds, the raiding marshals seized "equipment for the alteration or remarking of manufacturer's markings on electronic components including grinders, buffers, die stamps, markers, scrapers, paint, paint removers, labels, insignia and logos." Reportedly, branding equipment for virtually every semiconductor manufacturer was found.

Williams claims that PSI upgraded low cost parts in addition to changing brands. He cites, in one case, the purchase of 12,000 inexpensive Solitron transistors, which were remarked and sold as RCA 2N3055 devices. Williams says that PSI also bought a portion of an estimated 100,000 Intel 1702 integrated circuits stolen by an Intel employee. He also claims PSI came into possession of an Intel microprocessor development system that disappeared while en route from Mountain View to Culver City CA. The unit was seized by US customs officials as it was being reshipped to its Sao Paulo, Brazil destination.

PSI also had trouble with stealing by its own employees. In April it put on four armed guards for after hour patrol, following theft of 1702 ICs and other devices.

Richard Berger, the attorney for PSI president Jerome Friedman, says his client denies all of the allegations. *Reprinted from* Squelch Tales *(from* Electronic Engineering Times*), August, 1976.*

Targeted

In Chicago, at the Attorney General's office, Assistant Attorney General Howard Kaufman and his assistant John McPhee are swamped with mail. Kaufman heads the Illinois Consumer Fraud Division, and he's suing Irael Treger W9IVJ. Treger owns Trigger Electronics, the target of scores of ham complaints. The fraud division has processed more than 200 from hams in all 50 states. The prime complaint is non-delivery of ordered items, despite receipt of cancelled checks from the buyer. The AG's office has asked the court to permanently stop Treger from doing business, and distribute his assets. McPhee says Trigger used FCC listings of new licensees to ship catalogs, promising quick delivery and availability of several lines of amateur equipment. (A look at past letters to the editor column will indicate the results.) Trigger orders, when they were filled, took months. And more often than not they went unfilled.

McPhee told *73* his files show at least 3 years of mail order problems at Trigger, and in early October his office filed an amended complaint, charging Trigger with false practices. It seems that Treger had agreed to pay off his creditors through a verbal arrangement with McPhee's predecessor, but failed to comply. As McPhee put it, "I saw a lack of action . . . and now it's time to go after him." On October 8th, the State of Illinois took that action.

The Federal Government may get into the act as well, on grounds Trigger may have violated section 5 of the Federal Trade Act. That is the so-called "Truth in Advertising" provision, which requires advertisements crossing state borders to live up to their claims. Trigger was reportedly given three weeks to comply, but legal observers say a Federal suit can be expected. The Post Office also conducted an investigation into Trigger, but reportedly decided not to prosecute, because they could not prove intent to violate the postal laws.

Hams who have lost money in the Trigger mess do have some hope to collect, but they may not get a full refund. If Trigger filed for bankruptcy, for example, creditors could only expect to collect about ten cents on the dollar. (Legal sources in Chicago told *73* they fully expect bankruptcy.) Most of the Trigger victims are newly licensed hams, because of Trigger's use of FCC mailing lists. FCC spokesman Greg Jones told *73* the mailing lists are public information under the Freedom of Information Act, and are sold by an outside contractor.

73 tried to contact Treger, but was told he no longer worked for Trigger. Attempts to reach him through other channels have failed. The man who answered the phone at Trigger refused to answer any questions about the situation, and referred us to "the legal department" at the company's River Forest address. We are still waiting for their reply.

Hams who have had problems with Trigger are advised to send copies of correspondence, cancelled checks, or any other relevant material to Howard Kaufman, Chief Attorney, Consumer Fraud Division, Attorney General of Illinois, 134 North LaSalle Street, Chicago IL 60602.

Okino Tori Shima

The question of the Okino Tori Shima approval for the JARL 50th anniversary and the actions of the ARRL headquarters staff in bending the criteria to approve the "new" country status for this mostly submerged reef have been with us all through the spring of 1976. Bitterly opposed not only within the JARL but by amateurs and amateur groups in other countries as well as within the U.S., many were waiting to see what the ARRL Board of Directors would do with the problem at their July Board of Directors meeting at Denver. If you are to read the official minutes, you are going to be as much in the dark after finishing as when you started.

Using the now-familiar ploy of a "Committee of the Whole" to screen their actions, the official minutes give the following information.

15. On motion of Mr. Price, VOTED at 10:25 pm, that the Board does now resolve itself into a Committee of the Whole to discuss DX matters, and that the Headquarters staff, exclusive of the General Manager and the Communications Manager, be excused. The designated people departed from the meeting. The Committee rose at 11:35 pm and reported to the Board.

That's it! All of it!!

If you search the official minutes, a

Continued on page 18

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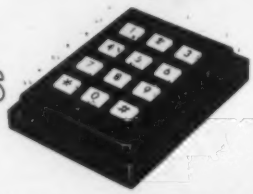

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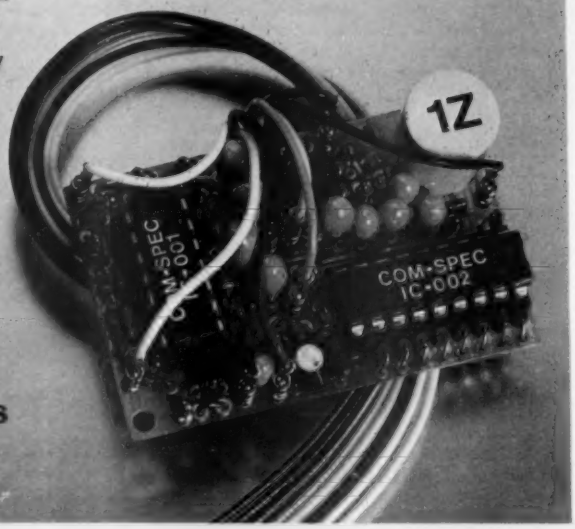

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from page 15

bit further along you will find a minute which could be intriguing. This is Minute 40.

> 40. On motion of Mr. Price, seconded by Mr. Cotterell, unanimously voted that the Secretary is directed to prepare a comprehensive indexed list of standing instructions of the Board now in effect. The list shall be accompanied by his recommendation for additions, deletions or changes as appropriate.

The report from the Committee of the Whole is not included with the minutes. It is presumed that as a committee report it will be available to the membership. However, if you are going to write for it, you will have to be specific, as there were a lot of "Committee of the Whole" actions.

> Minute 7. Committee of the Whole to discuss staff matters.
>
> Minute 15. Committee of the Whole to discuss DX matters.
>
> Minute 17. Committee of the Whole to discuss Docket 20777.
>
> Minute 43. Committee of the Whole to consider report of a committee appointed to prepare draft of League's position on FCC Docket 20777.

If one tries to analyze what took place, there seem to be indicators that more time was spent in trying to determine if the actions were procedurally correct rather than were the actions in themselves correct. The feeling is that the headquarters people were able to cite authority and precedents for the actions taken and this is perhaps the basis for Minute 40. It appears that the Board wants to know just what actions, decision-making authority and policy decisions it has delegated to the headquarters staff on a open-ended basis.

. As far as the question of Okino Tori Shima itself, the bending of the criteria to take care of another International Society, the twisted logic whereby an operation from the rocks at one time counts for Ogasawara but at another time for a "new" country has not been clarified. Certainly the plight of many concerned DXers is summed up in the quotation: "I call ... but no one hears ... no one answers."

Reprinted from West Coast DX Bulletin.

Red Cross Emergencies

WCARS is participating in a series of meetings with representatives of Disaster Services in the Western Area Office of the American National Red Cross, the Military Affiliated Radio Services and the American Radio Relay League. These meetings are being held to clarify the ARC emergency communications needs during major disasters in the US and to set up effective coordination of the various radio services. Primary results of these meetings to date are as follows:

1. The territory of ARC, WA covers from the eastern border of Montana to Guam on the west and from Alaska on the north to Palou Island in the south.
2. Based on availability, ARC uses communications systems in the following order:
   a. Commercial communications.
   b. Military Affiliated Radio Services through an understanding with the Department of Defense.
   c. Amateur radio communications.
3. The order of priorities for Red Cross communications needs are:
   a. Communications between the ARC job administrative units in the disaster area and also with government agencies in the area to meet immediate life saving and life supporting needs of victims (short range usually).
   b. Communications between the disaster job headquarters and a Division or Area Headquarters to get essential outside support and to let the job know when support is coming in (usually long range).
   c. Communications between the job headquarters and the ARC Disaster Welfare Inquiry Center to procure and provide information on the location and welfare of victims in order to answer inquiries from immediate family members in or outside of the affected area (short or long range).
4. ARC plans to immediately assign a communications expert on major disasters to determine the needs and make arrangements for use of the appropriate services.
5. A joint committee will explore the feasibility of setting up an emergency communications team with readily transportable equipment and availability for immediate response in areas where adequate communication services are not available.
6. Discussions of disaster welfare inquiries (DWIs) from immediate family members outside of the disaster areas brought out the following information on the Red Cross system:
   a. A DWI team is immediately assigned to set up a separate teletype equipped center, adjacent to the disaster area for collection of all information about the affected area and disaster victims, as this information becomes available.
   b. A moratorium on traffic is declared and remains in effect until the collection and communications systems are operable. This moratorium information is distributed by a teletype Disaster Welfare Inquiry Bulletin (DWIB) to all 72 ARC divisions, over 3,000 ARC chapters in the U.S. and all military installations with ARC field services (SMI). When the system is operable, the entire system is notified by DWIB of the location and terminal TWX.
   c. Inquiring immediate family members provide the local chapter or SMI office with the essential information on ANRC form 2079. The inquiry is forwarded through the system to the job DWI Center after the moratorium is lifted. The answer goes back through the same channel.
   d. Information concerning the moratorium time period, geographic areas affected and job terminal numbers can be obtained by contacting the local Red Cross. This essential DWIB information will be rebroadcasted by WCARS and other systems as soon as possible.

WCARS hasn't been called to bat yet. The major disasters so far have occurred outside the WCARS zone of operation. BUT, let's stay ready.

C. J. Weber
Director WCARS

Tough Break(er)

Clyde "Blue Rover" Rice was convicted of manslaughter Friday in the death of another Citizens Band radio operator after the two had argued over use of a CB channel.

Rice, 31, of Lincoln, Neb., was charged with first degree murder but the jury convicted him of a lesser charge of manslaughter.

Rice was charged with running down Donald "Bear Tracks" Edelman with his pickup truck in the parking lot of the Veterans of Foreign Wars hall April 10. Edelman died three days later.

The two men, authorities said, had battled verbally over the air waves for several months over the use of CB channel 23. Rice was known by his nickname or "handle" of Blue Rover on the CB radio band and Edelman was called Bear Tracks.

Judge William Blue set bond for Rice at $15,000 and continued the proceedings pending a presentence investigation.

Reprinted from the Pacific Stars and Stripes, *July 27, 1976.*

Review

NOVICE CLASS STUDY GUIDE

With the publication of the new *Amateur Radio Novice Class Study Guide*, *73* has again been able to maintain its lead in the amateur training field by keeping the content of its materials for prospective hams well ahead of the rest of the market. The new guide is the most up-to-date aid available to all those seeking a ham ticket. Right from the very beginning the materials are presented in a clear concise manner, making the complete understanding of Novice theory and the FCC rules and regulations as easy to the neophyte radio enthusiast as any learning experience could be.

In keeping with the FCC's move to include more advanced material on the Novice exam, the new *Novice Class Study Guide* has been updated and expanded to include more detailed sections on radio wave propagation, filters, receivers and rectifiers.

The subject matter is arranged in such a way that one chapter feeds on the preceding and is a necessity for a complete understanding of the next. Starting off with a thorough description of the terminology one is to encounter in ham radio, the book proceeds through basic definitions of electricity, resistance, capacitance and inductance to simple circuits and applications of Ohm's law. The text then continues on through amplifiers, vacuum tubes and transistors to receivers, filters, rectifiers and transmitters. A thorough discussion of radio wave propagation follows. The entire last section of the book is devoted to rules and regulations and includes the latest update from the FCC. Study questions and the essay tape are included and the book ends with one of those hard to obtain FCC 610 forms for license application.

The *Novice Class Study Guide* follows the philosophy of all *73* publications which are geared for license advancement, to teach the material and not run a series of vague questions and answers which is more conducive to memorization than to learning. It is a logical conclusion that much more enjoyment can be obtained from a hobby if the fundamentals of the hobby are thoroughly understood. A mere memorization of questions to pass the test is not enough for a long term enjoyment of the hobby and can become very sticky if the FCC pulls a "no-no" by rephrasing their questions.

A good understanding of the Novice test matter also provides an excellent foundation on which to build for the General and Advanced class exams which will come later.

This guide is used in conjunction with the Novice code tapes, which are also produced by *73*. There is no better teaching aid for the prospective Novice. The code tapes, which consist of a 5 word per minute learning tape and a 6 wpm practice tape, are the best on the market. The characters are sent at 13 wpm and the spacing between characters is at 5 wpm. This allows the beginner to learn the code only once and to accelerate progress toward General or Advanced (just close up those spaces).

As a package, the *Novice Class Study Guide* and tapes would make an excellent Christmas present. *73* also has special deals for clubs which are offering Novice classes. When it comes to studying for the Novice class amateur radio license, the materials offered by *73* can't be beat with currently available materials.

Tracking the Hamburglar

TAKEN: One GTX-1T handie-talkie, s/n 10-59 with .13T/.73R, .25T/.85R, .52T/.52R, .72T/.12R. Taken from Genave Radio Expo '76 booth in Chicago, Sept. 18-19, 1976. Anyone with information on this radio is requested to contact the Genave factory. General Aviation Electronics, Inc., 4141 Kingman Drive, Indianapolis IN 46226, (317) 546-1111.

RIPPED OFF: Icom 22S, s/n 0017, channeled for: #1 16-76, 2 34-94, 3 22-82, 4 28-88, 5 52-52, 6 37-97, 7 07-67, 9 19-79, 12 25-85, 15 7.63-03, 17 7.87-27. Has total of nineteen channels programmed in first 20 positions, no channel 19. All above 15 are 147 meg. Ken Keyte WØTGL, 3812 Windsor Ave., Colorado Springs CO 80907.

HIJACKED: Icom 230 2 meter radio, s/n 240-2915, forcibly removed from vehicle in Fort Wayne, Indiana on September 4, 1976. Report filed with Fort Wayne police. Kenneth C. DeGroff WB9OCW, 62322 Oak Road, South Bend, Indiana 46614.

RIPPED OFF: Kyokuto FM-144 2m transceiver, s/n 6215. Stolen from vehicle at Los Angeles Coliseum on July 24, 1976. Contact Abel J. Tapia WA6FSZ, PO Box 414, Montclair CA 91763.

TAKEN: Wilson T1402 S/M 2 meter handie-talkie, s/n OR6427. Crystals for 52/52, 22/82, 25/85, 16/76, 34/94, 69/09. Stolen from James Hettle, PSC #1, PO Box 2493, Peterson AFB CO 80914.

RIFLED: Heathkit HW-202 with installed Tone Burst Encoder, TTPAD, six (6) sets xtals 34/94, 94/ , 25/85, 115/715, 28/88, 16/76 (switch indicates 04/64 but xtals are 16/76). My ssn 125-32-5960 on various parts internally including underside of trans and rec boards. Also stolen: Courier Comet 23 CB, s/n 12300643. Stolen from my parked auto in Garden City NY on August 30, 1976. If found, please contact heart-broken owner, David K. Gordon WB2YUJ, 155 Nimbus Road, Holbrook, NY 11741.

STOLEN: Drake TR-22 2 meter transceiver, s/n 640139, beige Trimline TT Handset, magnet mount quarter wave antennae. Crystals for 52/52, 16/76, 37/97, 87/27, 63/03, 34/94. Stolen from Rick Simpson KØUZP, 2723 Rigel Drive, Colorado Springs CO 80906, 303-471-2059.

PURLOINED: TR22-C s/n 850278; Swan 350 s/n C847975. These were taken from my automobile at the Northwest Plaza shopping center in St. Ann, Missouri on June 24, 1976. Please contact W2ZKE, 1150 Staffler Road, Bridgewater NJ 08807.

ROBBED: One Tempo VHF/ONE 2 meter transceiver, s/n 5728. Also Western Electric touchtone pad. Stolen from car on August 20, 1976 in a San Francisco parking lot. Reward. Contact: Shel Kurtzman K6RMM, 19436 Topham Street, Tarzana CA 91356, or phone (213) 344-0878.

RUSTLED: Drake MN-2000 matching network, s/n 6485. Heath SB-650 frequency counter. Stolen on August 29, 1976 from auto in Rockland County. Please contact Cliff Cooley, Jr. WN2GHL, 4 Camp Hill Road, Pomona NY 10970.

ROBBED: Yaesu FR-101SD1G HF digital receiver, s/n 6C31339. Yaesu FL101 HF digital transmitter, s/n GE306276. Stolen from Associated Electronic Service, 404 Arrawana, Colorado Springs CO 80909.

Ham Help

Does anyone have any plans or info for a good noise blanker circuit which will work effectively on SSB in a National NC300 receiver?

I would really appreciate any help on such.

Joe Demke W7KCF
PO Box 182
Vernonia OR 97064

I am in need of a service manual and/or schematic for a Lafayette HE45A 6 meter transceiver. A copy of same will do fine. Thank you.

W. A. Carl WA3YUB
643 River St.
Scranton PA 18505

I would like help getting my Tech license and info on 2m and above equipment. I'm familiar with computers. I have a 6800, 6502 and a TM9900, although I've had a 8080 system. I would like to hear from any ham who needs help with computers and could help me. Phone: (201) 343-8072. Thank you for your help.

Bruce Lill
Apt. 17-A
399 Prospect Avenue
Hackensack NJ 07601

It was suggested I write to you on the subject of obtaining my Novice class amateur radio license.

Any help would be greatly appreciated. Thank you.

Ron Sklaver
200 S. Middle Neck Rd
Great Neck NY 11021

I am interested in putting an ATV repeater on the air and would like a group of 3 to 4 people interested in the same.

Earl Clark
550 Fiske Drive
Detroit MI 48214

We are in the process of adding autopatch to our new repeater. We have a good touchtone decoder which has a digital output in either decimal 1 through 10, or BCD weighted 1-2-4-8.

The problem? The dialer portion. We need the part that first will store the seven digits as fast as they are entered and then pulse out the numbers at the proper rate and digit spacing for General Tel system. It should also not accept long distance numbers, by possibly storing a maximum of 7 numbers. Any schematics or other information that would help in the construction of this pulser (dialer) would be greatly appreciated. Thank you.

Jim Wagner WB8HFJ
R #2 Box 49A
Scottville MI 49454

I'd be glad to help anyone in the Pittsburgh area in their amateur studies — up to and including the Advanced Class.

Gregg Corsello WN3LDK
226 Waldorf St.
Pittsburgh PA 15214

Novice Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.

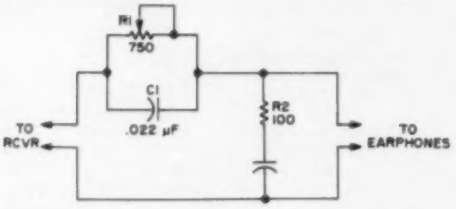
Q. What is the best way to measure frequency drift on a transceiver?

A. The best way is with a good, commercial-type frequency counter. Be sure not to confine your drift measurements to one band or only one or two frequencies within a band – drift will usually vary according to frequency.

If a counter is not available, a good stable heterodyne frequency meter is needed. With both the receiver and meter warmed up (24 hours or more), put the meter and set on the same frequency and let both alone for a couple of hours. Then re-zero the meter to the receiver frequency. If your dial can be read closely, plot the difference frequency on a chart. Repeat with different frequencies.

Q. How can more uniform response be obtained from a pair of magnetic headphones having a dc resistance of around 4000Ω? At around 1000 to 1350 Hz they seem to be rather resonant.

A. Refer to the figure. Both treble and bass will be boosted some 16 dB with this circuit. Adjust the 750Ω pot to suit your individual listening pleasure. When the total resistance is in, the boost mentioned will occur.



Q. Is there a practical circuit diagram for a simple SSB-CW noise limiter which is easy to install in a receiver which has a good product detector?

A. Semiconductor diodes may be used (see the figure) instead of a dual-diode tube, but they must have a high front-to-back ratio.

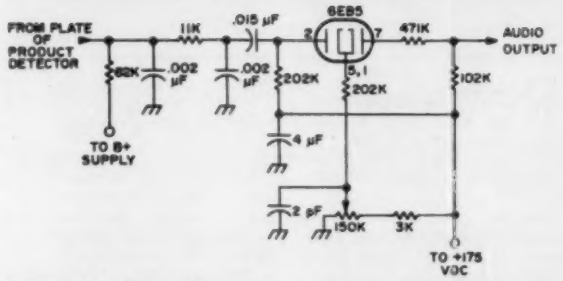
Q. What could cause TVI from a good-working communications receiver?

A. The high frequency oscillator has too much second harmonic radiation. To prevent this, tighten up the front panel screws; add external lockwashers under each of the rear chassis screw heads to insure a good metal-to-metal contact. Next, install a piece of heavy aluminum foil around the receiver chassis edges.

If these measures do not solve the problem, on some receivers you can solder a 1000Ω, ½ W resistor from the 10-30 MHz HF oscillator coil tap to the B-plus bus.

Q. How can coax cable be checked for moisture or leakage?

A. If a "megger" – an instrument that reads in the thousands of megohms – is not available, use a scope. If a scope is not available, a VTVM on the highest resistance range may work. With dry, well-insulated coax an infinite reading should be obtained with the VTVM. With a megger, the higher the reading the better. Connect any of the instruments mentioned between inner conductor and the shield to check for moisture. Make sure the inside of any connector used is clean and dry.



Q. When using an inexpensive vertical antenna, can radials be installed?

A. Yes, six or eight wires twice the length of the vertical can be installed in shallow trenches, and improved performance will be noted.

Q. What would cause the final plate current meter in a small transmitter to burn out, if it was not overloaded?

A. Switch connections should be checked for a possible short. In some sets, having no clamp tube, momentary loss or rf excitation can cause large current surges that can burn out a meter. If possible, replace the regular meter with an 0-500 dc milliammeter for reading total final plate current and watch for surges – especially when set is turned off and then turned back on while tubes are still hot.

Q. What is a good study guide for the Novice class amateur license?

A. The Novice Class License Study Guide, *available from 73, is a very good reference, as it is by far the most up-to-date publication available on this subject. Other manuals and guides have not been revised nor sufficiently updated to include the latest changes in the FCC exams. The advantages of this type of guide are retention and complete understanding of the electrical theory, rather than hasty memorization of questions and answers. There are similarly good books for the General, Advanced and Extra class licenses from the same source.*

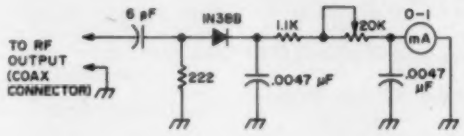
Q. How can spurious signal responses be attenuated at 21 MHz?

A. First, check receiver alignment. If this is correct (and frequently it isn't), connect a National R60-4 coil in parallel with a 51 pF variable capacitor. Now wire this combination in series with your antenna. This should provide up to 78 dB suppression of unwanted signals between 13 and 36 MHz.

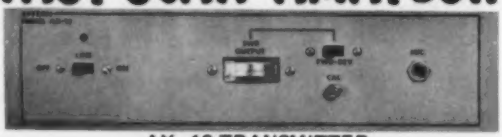
Of course, you must adjust this circuit from time to time – depending upon the frequency you're listening to.

Q. Is there a simple circuit for a good rf output indicator?

A. To provide external control of the circuit shown in the figure, the pot is placed next to the meter and is used to adjust for maximum desired indication on the band used. If operation is mainly on the lower bands (80-40 meters), use a 7 or 12 pF in place of the 6 pF unit shown. The 6 pF is adequate for use on 20 through 10 meters. In some transmitters the "driver current" position of the meter switch can be used, inasmuch as it is not often used on SSB.



FAST SCAN AMATEUR TELEVISION EQUIPMENT



AX–10 TRANSMITTER

AM–1A RCVR MODEM

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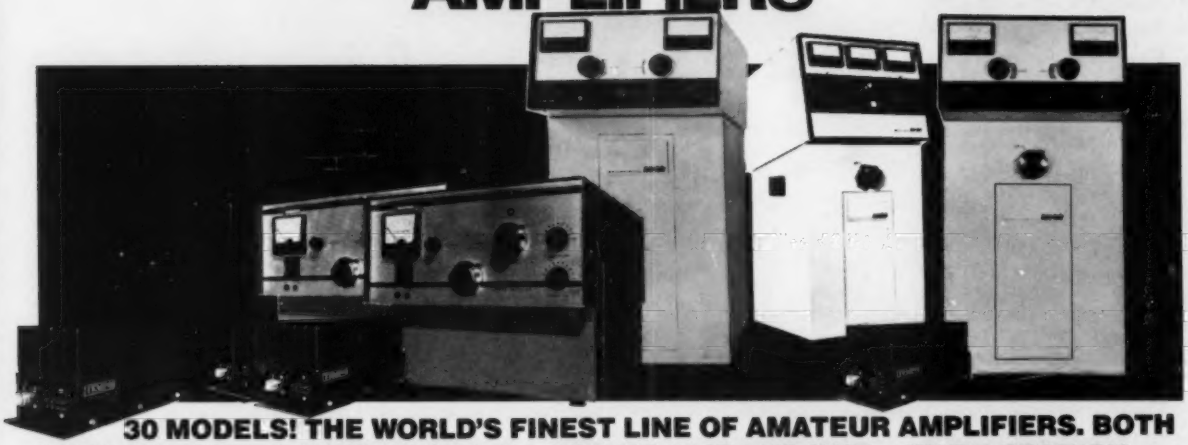

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Build This Inexpensive 400 Watt Amplifier

-- a pair of shoes never hurts

Photos by Gary Gray

The popularity of push pull circuits in rf amplifiers dropped off shortly after World War II. The use of the pi network pretty well solved the harmonic problem, worked well with a single tube or two tubes in parallel, lent itself to bandswitching, and used a few less components. However, with the advent of TV, everybody started putting low pass filters in the output line anyway, so we are just about back to where we started from. So let's take a look at push pull again.

The number one objection to push pull seems to be the necessity of an input tuned circuit to get the grids 180° out of phase. As will be seen later, this problem has been eliminated. Secondly, the push pull circuit does not lend itself to bandswitching. This is true, but there are people who are interested in one band only. Also, with a small compromise in L/C ratio, you can cover two bands with one coil. This is especially true if the two bands happen to be 15 and 20 or 10 and 15. You can even cover 10, 15 and 20 if you prune very carefully and use a fairly sizable maximum capacity tuning capacitor. Another possibility, the one used in this article, is the National all band tuner, which does away with bandswitching entirely.

Of recent date the grounded grid circuit has come to the forefront. It requires no neutralizing and is ideal for the exciter that already has considerable power output. How about a push pull grounded grid? It ought to work fine, but we have all of that circuitry mentioned above. It ain't necessarily so! It occurred to me that since this is a low impedance circuit to the input, a 4:1 balun could be used to get the push pull excitation. Accordingly a two inch toroid core was ordered from Amidon. Upon receipt of same, we wound 8 turns of 72 Ohm ribbon (receiving type) on it, as per page 162, 1975 *ARRL Handbook*, and discovered that the drive to the grids was about the same as that derived from a tuned circuit. And it works on all bands.

The circuit in Fig. 1 will work at any power level but in this design three restraints were imposed. First of all, the all band tuner is rated at about 1500 volts, and it was desired to voltage double an old TV power transformer for the dc supply which also comes out about 1500 volts. Secondly, the box to be used was of limited size, so the number and size of components had to be kept at a minimum. Last but not least, operation without a fan was desired.

Grounded grid with a filamentary cathode is a headache because you need to have big, bulky, hard to mount, filament rf chokes which are expensive if you buy them ready-made. An indirectly heated cathode is much to be desired. A pair of 7094s was on hand. These were ideal except at 1500 volts they don't operate at maximum ratings. Several power tubes with indirectly heated cathodes and higher dissipation ratings have come out recently. Obviously many of the TV tubes could be

used in the circuit, operated at lower voltage and power levels.

Fig. 1, using the all band tuner, was selected. Trial one did not include the ferrite beads and trouble with parasitics was experienced. Beads were added to the grid circuit primarily because the grids were easy to get at. Beads in the plate circuit might be better. Ordinary parasitic chokes with shunt resistors will do the same thing. Beads seem to be the cheap and easy way to do it. At any rate, the parasitic problem was solved. The plate circuit pickup coil was tapped and the taps connected to a rotary switch. This gives adjustable loading ability. If you have a set of BC 610 plug-in coils with a swinging link, you get the same effect, only it is continuously variable.

The unit shown in the photos uses a box left over from some former project. It is in the vertical position shown because of the National all band tuner which fitted best this way. All of the power supply is in the bottom. The rectifiers are actually 5 1000 V piv diodes on each side, without any voltage dividing resistors or capacitors.

At 10¢ each, it's too much trouble to add resistors and capacitors. Just put in twice as many diodes as required for the voltage. It saves space. The front panel is a piece of aluminum sheet from an offset printing system common to many newspapers. You can buy these sheets for 25¢ each and they yield nearly two square feet of aluminum. They are pretty thin but, as in this case, will cover an old panel with the holes in the wrong places. The switches are ordinary toggle switches mounted on the grounded front panel. There has been no voltage breakdown to date. You could mount them insulated but then touching them might be an electrical hazard.

If you use the all band tuner, you should carefully check the output frequency with a wave meter (grid dipper on diode position). Make sure you have the right band and mark same on the dial. For example, the 40 meter and the 15 meter points are close together. You could be tuned to 15 when you think you are on 40 if you are not careful.

Results

With the restraints listed, we were able to get about 400 Watts dc input (800 Watts PEP if you like that definition). This would be a very effective setup for an SB 33 or SB 34 or other transmitter in that size range. The Argonaut is a little small, but it yielded about 50 Watts out. This corresponded to about 150 Watts input – practically class A.

An SB 10 was also tried, and yielded about 300 W dc input. An FT 101 is actually a bit too large for a driver; you can't run it full bore. The output of the linear is only about 2½ times the full output of an FT 101. You need to have at least a 4 to 1 step up to make a linear worthwhile. If the same linear were built with a 2000 volt supply and 2000 volt components, the FT 101 or similar would be about right.

If you are not limited by space or circuit considerations, a linear of this kind using larger tubes would easily run full legal power when driven by a standard transceiver.

Try a push pull grounded grid. ■

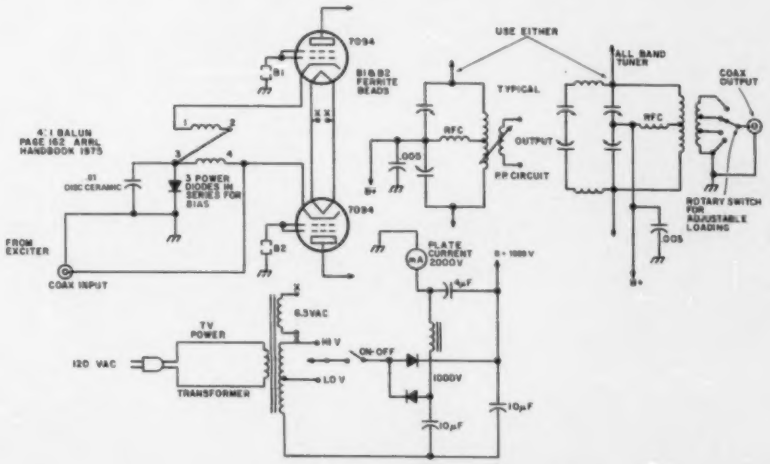

Fig. 1. Push pull grounded grid linear.

How Do You Use ICs?

-- part V

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Just for sheer bulk and apparent circuit complexity, the actual counting and digital readout circuit of a frequency counter is enough to turn most amateurs off on sight.

As this often is the largest single part of a counter or most other equipment using such a readout, when you get scared off by this you don't bother with the rest of the equipment either.

This is a shame, because once you understand this part of the circuit, almost half of the piece of equipment will fall into place in your mind.

Just as with the timing chain, the readout chain can be broken into bite-sized pieces which will put the whole thing into simple perspective.

When you understand one digit in the readout, you just about understand them all. When you are looking at this mammoth wad of ICs, you are really just looking at the same thing repeated over and over again. It really is that simple.

To understand what this circuit is, we will concentrate on just one digit with a simple circuit that is very easy to duplicate if you have an IC test setup.

While there is a whole fund of complex information available on how the ICs involved perform their task electronically, this is unnecessary for your purposes.

You don't have to know how the ICs do the job – that's their problem. What you want to know is how to make them do the job for you.

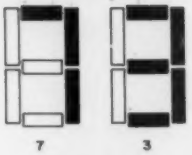

Fig. 1.

To do this, it helps to think of a digit of readout as consisting of three parts. Whenever you need a digit you will think of these three parts automatically.

We will start with the end result, the numerical readout itself. Since the IC field changes so fast, what is available has changed rapidly in just a few years.

Some of the older circuits relied upon two types of readout devices, individual indicator lamps (ten per digit) and the "Nixie," which was a neon type of tube. These were both clumsy to use and are no longer in common use.

The thing that made the difference was the sudden availability of LED readouts at a cheap surplus price.

The name LED stands for Light Emitting Diode. It does just what its name implies. It is a diode that lights up when current flows through it. The higher the current, the brighter the light, up to the point where it gets damaged by too much current.

These are also known as seven segment readouts. This is because there are seven individual segments made from LEDs that form the number. The various digits are formed from selected combinations of the LEDs, giving the numbers that distinctive computer look.

Fig. 1 shows two numbers as they would look when lit. This is the simplest recognizable method to get all of the numbers.

As we are talking about diodes, they have many characteristics in common with all other diodes. They have an anode and a cathode.

In operation, the readout is either of the common anode or common cathode type. This means all of one or the other are returned to the same point. This is important to keep in mind when coming to part two of the hookup.

Fig. 2 shows the block diagram of the three parts of the circuit. The middle part is the driver for the readout IC. This and the readout are sort of a matched pair.

While there are a number of readouts available, there seems to be a favoring of the MAN-1 type. This is also similar and interchangeable with the SLA-1 and the Data Lite 707. They are all of the common anode type.

These are usually driven by the SN7446 (or just 7446) driver IC which is designed for this service. The generic name for this type of IC is the BCD to seven segment decoder/driver. The BCD part

will be explained shortly, but let's start with the driver part.

It is the job of the middle IC to take information supplied to it and light up the correct segments to form the required number. This is why it is called a decoder/driver.

Fig. 3 shows its hookup to the readout IC. This seems quite complicated but it really isn't once you understand about those resistors.

The diodes require a certain amount of current to light up, but with too much they will be destroyed. The one in the test unit was rated at fifteen mA per segment (or a total of 105 mA for full brilliance).

One of the things that increases the value of a readout is that it requires less current than another. Five of these is half an Ampere. There are ways around this.

The primary purpose of the resistor is to limit the current to each segment to a safe value. Notice that all of the resistors are the same value. In a multi-digit display all of the other resistors in this position will be of the same value.

This usually will not be critical, within reason. Typical values range between 220 and 1000 Ohms at a quarter Watt. The higher the value, the dimmer the display (but the less the current).

These resistors are cheap (in quantity) when you go to put together a full display, so don't worry about the number. Once you realize that you are just repeating the same thing, it makes wiring easier, too.

The readout does what it is told. It gets its orders from the decoder/driver. The driver is told what to do by the third element of the circuit, which is the counter IC.

(While it is not part of the counting circuit, most LED readouts have at least one decimal point either to the left of the digit or to the right. Some have one on each side.

This is fed from the same Vcc source as the readout,

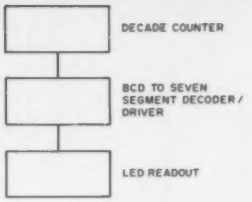

Fig. 2.

and commonly has the same value of limiting resistor in series with the Vcc voltage. The pins may be located by applying the voltage through a resistor to the "extra" pins and seeing what lights up.

The decimal point has nothing at all to do with the counting circuit. It is arbitrarily selected by switch action.

The position is chosen at a certain point on the display by the requirements of the value the display is showing. Thus a four digit display showing Hz would display 2100 and the same display set to show kHz would display 2.100.

This is usually done by a multi-gang range switch. While other sections are selecting the electronics for the given range, one gang is used to select the required decimal point position on the display and illuminate the correct decimal point for the range.

This action is completely independent of the other electronics of the counter. It is all done by the switch.)

Most of the counters use the 7490 decade counter IC. This has been shown previously in its application as a frequency divider, but its main purpose in life is to count.

The internal process is highly complex, but for our purposes there are only a few things to keep in mind about what it does.

It counts. That is, every time it is pulsed it produces an output to identify that pulse as part of a sequence from one to ten.

At the tenth pulse it performs two functions. It starts in at the beginning of

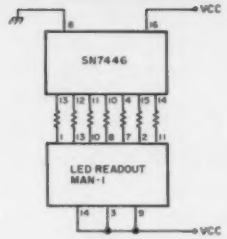

Fig. 3.

the ten count sequence and it produces a pulse to go on to the next link in the counting chain.

So for every ten pulses, it produces counting information for the decoder to use and one output pulse for the next stage.

And now a word about BCD. The decoder/driver was listed as a BCD to seven segment decoder/driver. As a previous article mentioned, many of the pins have letter names relating to their computer function. The particular outputs of the 7490 that go to the decoder/driver are labeled A, B, C and D.

Putting the whole thing together will give you the electronic capability to count and display pulses. Fig. 4 shows a very simple circuit which can duplicate the action of the larger equipment.

This circuit will actually show the numbers in order on the readout. It is a simplified circuit and not quite what you will get in an actual counter. There are some fancy improvements built into the ICs that were disabled for simplicity. They will be discussed later.

First, the counting action. Notice pin fourteen in the schematic. This is the 7490 input pin. The pulse input to here is what gets "counted" by the IC.

The purpose of the pulse is to key the IC and make it work. To work, the IC must be turned on and off. It does this by being switched between a high state and a low state.

Usually the 7490 is switched by an IC gate in a counter circuit. In this circuit a 7400 gate is hooked up as a "bounceless switch" to pulse the counter IC.

The reason for the bounceless switch is to produce a clean pulse for the 7490. If an ordinary switch were used, it would have a slight amount of contact bounce (that is, the switch contact would not just make one clean contact but would mechanically make and break slightly before coming to final rest). For many purposes this would not even be noticed by the circuit, but the IC counter is a very high speed sensing device and will actually count these extra pulses.

So the 7400 is used to switch the 7490 cleanly. An SPDT switch can be used to control the 7400. This can be the momentary contact push-button type or the ordinary type. The push-button will perform the reset operation of the 7400 automatically. Otherwise, the operation will have to be done manually.

The 7400 switch is actually a form of flip flop circuit. When it is pulsed it goes from its original state to the new state and remains that way until switched back. Thus, to continue to pulse the 7490, the 7400 will have to be reset to its original state for each new output pulse.

The test circuit didn't even use a mechanical switch for the 7400 – just a clip lead which was switched between the correct IC terminals to affect the 7400 switch action.

When you change to nine, the next number will be a return to zero. Then the counting cycle begins all over again. These are the basic mechanics of the numbering system. You next have to learn to count with it.

With a little practice you will be able to pulse the 7490 quite quickly, particularly if you use a switch rather than a piece of wire. For the sake of example, let's assume that you can get only three pulses per minute.

With this circuit, in the first minute you would reach the count of three. In the second minute you would reach a count of six and in the third a count of nine.

This circuit can be thought of as a basic event counter. It will go on counting how many times something pulses it until it runs out of numbers.

Even with just a simple event counter, there comes a time when you want to be able to reset the circuit to zero to start counting from that point again.

With this simple circuit, this can be done by turning off the Vcc voltage and turning it back on again. This will return the readout to zero, but it would be impractical to do this with many actual working devices. It would upset too many other internal circuits.

What is needed is a reset circuit. Fortunately, such a problem was thought of by the designers of the device, and there is a built-in answer. There is a reset circuit within the 7490 that does the very thing needed.

Actually there are two built-in reset circuits, but the one we want is called the zero reset. There are two pins for this, pins two and three.

The operation of the circuit is easy to duplicate in simplified form with the modification shown in Fig. 5; however, it may not appear exactly the same in actual use because it will not be performed in this manner. The principle is the same, though.

The only thing changed is that pin two, which was grounded, now has a switch in the circuit. Pin three is unconnected and left floating. Only one pin is needed here to control the reset action.

Assume that you are still pulsing the counter at the rate of three counts per minute. At the end of the minute you push the push-to-break switch at pin two and release it before the next counting pulse. This will cause the readout to return to zero before the next pulse, so that the count will again pick up with one and count on from there.

In a real frequency counter circuit, there will be a pulse supplied from the timing chain to perform this task. It will also "gate" the counter (in other words, apply the signal to be counted to the counter for a specified amount of time and reset the circuit to provide a continuously updated count).

As this must be done in microseconds or so, it sounds like it would take some doing, but the circuit is usually just a few IC sections.

Using the push-button at any time will return the readout to zero. This is how things like elapsed time circuits are reset.

There is one other reset circuit built in which you should know about, although it has yet to find common use in any amateur application.

Just as pins two and three control a return to zero circuit, pins six and seven comprise the same reset feature to return to nine. It works the same way and the effect can be shown by grounding two and three, leaving either six or seven floating and switching the remaining pin from ground as was done with the zero reset pin.

That's it for the basic operation of the counter part of the circuit. There is another feature of the decoder/driver that is commonly used and should be understood.

Left to its own when properly hooked up, all of the digits in the display would light up as zeros. This would be OK if the frequency was 1000 Hz, for example, but could be confusing to the eye if 20 Hz registered as 0020.

Considering how much the 7490 does for you, it would be unfair to expect it to attend to all the little details, so the feature that deals with the zeros is built into the 7446 decoder/driver.

It is called zero blanking. It's not necessary to go into detail about how it is done, but it is important to know which pins are used and how to make them do the job.

Fig. 6[1] shows part of a larger digital readout. This is virtually identical to the one digit circuit already shown. The basic differences are just the mechanical ones caused by the physical hookup of the circuit and the additional built-in features to be used.

Notice in Fig. 4 that pin five is connected to pin 16, the Vcc source pin. This is one of the pins in the zero blanking circuit that was disabled for the test circuit.

In Fig. 6 it is connected to pin four of the following IC package in order to do its job. The circuit starts with the highest significant figure (extreme left of the decimal point) and works towards the right (decimal point).

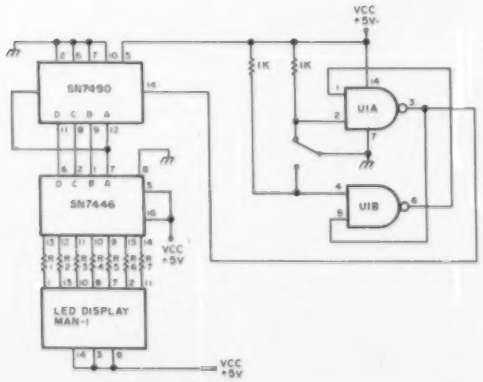

Fig. 4. R1-7: 220 to 1000Ω ¼ W. U1: SN7400.

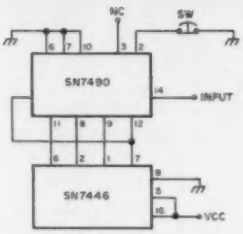

Fig. 5.

If the most significant digit is a zero, the circuit will blank it out and continue until a decimal position shows a number other than zero. It will not blank out the zero in a number like 101, but 001 would read as 1.

For several reasons, you probably will not see an actual circuit just like this one. It is not normal to blank out digits on such a small readout, and the least significant digits of a larger readout would not use the feature. They would be connected to read normally.

These are minor circuit considerations which can easily be seen by inspection of the schematic. Once you know what you are looking for, or at, it is easy to understand.

The least important digit is very important to the circuit operation. This is the one immediately to the left of the decimal point. Even though it may only be tens or hundreds of cycles per second, it has a major effect on the operation of the whole circuit.

The frequency to be read is fed to the least significant decimal place first and works its way up the chain. This is very important.

It does not go from the most significant figure and work its way down. From a practical viewpoint this means several things must be taken into account.

Even though it reads out to a lowly place on the scale, this first IC may determine the highest frequency that the counter can count. It will be operating at that frequency and dividing it down from there.

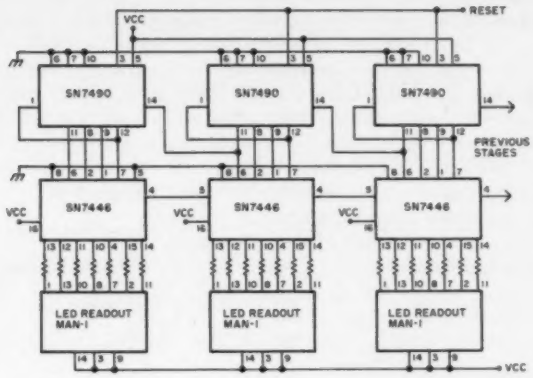

Fig. 6.

It is not common to see a counter using the 7490 in this position. It's too slow. It is only expected to work at around 20 MHz. While a selected IC might be able to go higher, the usual thing that is done is to use a high speed decade counter in this position.

As this may not be the same thing electronically, it will spoil the symmetry of the circuit visually and you will have to watch the wiring carefully. That is all it will be, though, and when you watch for it there should be little trouble understanding the differences from this simple circuit.

It is time to go a little more deeply into what is happening around the readout section and controlling it from the outside.

There are two important things going on outside the readout strip that are essential to the operation of the counter. One has been explained, the reset function. The other is the "gating" of the input signal.

Both of these functions are controlled by the timing chain. It is a pulse time signal from there that acts upon the readout section.

In order to count a rate of speed of an incoming signal, you have to be able to admit it to the counting and readout section for a known specific period of time.

This is called gating, which is also quite literally how it is done. Often a two input NAND gate IC is used for the purpose, as shown in Fig. 7.

Basically, the input signal is sent to one of the inputs. A NAND gate will not have an output when there is a signal applied to both gate inputs at the same time. This is the timing pulse which turns this gate on and then off for a specific time period.

Hence the name gating. The readout displays the count that has been established by the circuit during the time the signal is admitted to the counting circuit.

When it comes time for the next count to begin, the same timing chain supplies a pulse signal to the reset pins to reset the readout in time for the next counting period to come through the gate.

This function is usually handled by a single section or so of an IC and is done with high and low logic.

There is one other usual action performed on the readout, and there are two ways it can be done. Only one is used commonly in simple circuits, so it will be described first.

Each section of the readout IC can draw about 15 mA. That's over 100 mA per digit, or over half an Ampere for the whole readout section (just the LED ICs, not the 7490s or 7446s).

To help lessen the load on the power supply, it is common practice to strobe the readout ICs. This means that they are not running full

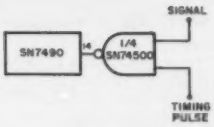

Fig. 7.

time, but are turned on and off at a high rate of speed so that the eye is fooled into thinking they are running continuously.

This is almost easier done than said. Fig. 8[2] shows a basic circuit. It is in the common line of the readout ICs. A switching transistor with suitable power rating is switched on and off by the same timing pulses that work the reset and gating ICs.

Thus the readouts draw an average current that is quite a bit less than the total current they would draw running full time – and the power supply runs cooler.

It is not hard to include this action in the timing sequence so that the display is blanked during the actual counting period when the digits are changing and a blur. Then when the counter has arrived at its count, the numbers are displayed and can be read. Then the display blanks out during reset and the whole cycle begins again.

This is done so fast that to the eye it looks like the display is steady. In fact, it is recounting the frequency a number of times and redisplaying the answer. Unless there is a change in the frequency, the readout will be the same. If there is a change, the counter will display an updated reading.

There is another method of strobing the display, but being more complex, it is not so common in simple equipment and will only be briefly described.

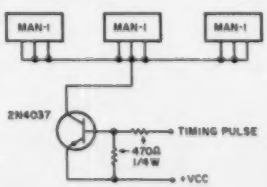

Fig. 8.

A timing pulse is given to a decade counter and the output signal is sent to a decoder/driver as with the readout circuit. However, instead of the decoder/driver feeding a readout IC, each output would go to a separate digit of the display, turning each on in sequence.

Thus, instead of turning the whole display on and off at a high rate of speed, each individual digit is turned on and off in sequence.

To the eye, the effect is the same. The display looks lit at all times, but since only one digit is actually on at any given time, the average current is less than with the other method. However, it is more complex.

While the basic readout circuit has three parts, there is a slightly more complex form of readout circuit which has four sections.

Several circuits have appeared recently using this configuration. The fourth section is a temporary memory which goes between the counter and the driver/decoder.

This is a latch type IC. It involves no new problems in understanding – only the mechanical problem of wiring.

One digit of a recent

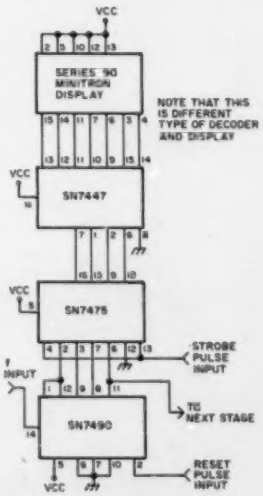

Fig. 9.

schematic is shown in Fig. 9.[3] As can be seen, it is quite simple and should not be any problem if you wish to construct a circuit using this feature.

Notice in this circuit that the strobing function is done by this latch IC. The rest of the counter did not conform to the guidelines given. It used the 7490s all the way through the readout section. In this case a high speed IC was used to prescale the count so that the frequency limit of the 7490 was not a factor.

The gating function of the counter took place just before the prescaler and used a different type of two input gate (a NOR) than described in the simple circuit.

This is still basically similar to the simple counter readout. If you understand the general operation of the simple one, you should be able to recognize the variations for what they are: just slightly different ways of doing the job.

As the IC scene keeps changing, it can be expected that any given circuit will not look exactly the same as the simple test circuits shown. In the near future though, the readouts will probably bear a strong family resemblance to what has been presented here. Once you know what you are looking for in the way of differences, the whole readout section should stand out as an easily comprehensible unit.

Since this and the timing chain comprise the most part of the usual frequency counting circuit, you will be able to concentrate on the other sections and should be able to understand and duplicate what you want. ■

References

[1,2] "Six Digit 50 MHz Frequency Counter," Pollock, James W., WB2DFA, *Ham Radio*, January, 1976, p. 18.

[3] "A Fun Counter Project," Plavcan, Al, *73 Magazine*, July, 1976, p. 36.

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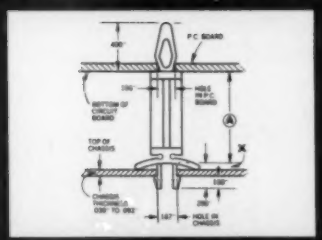

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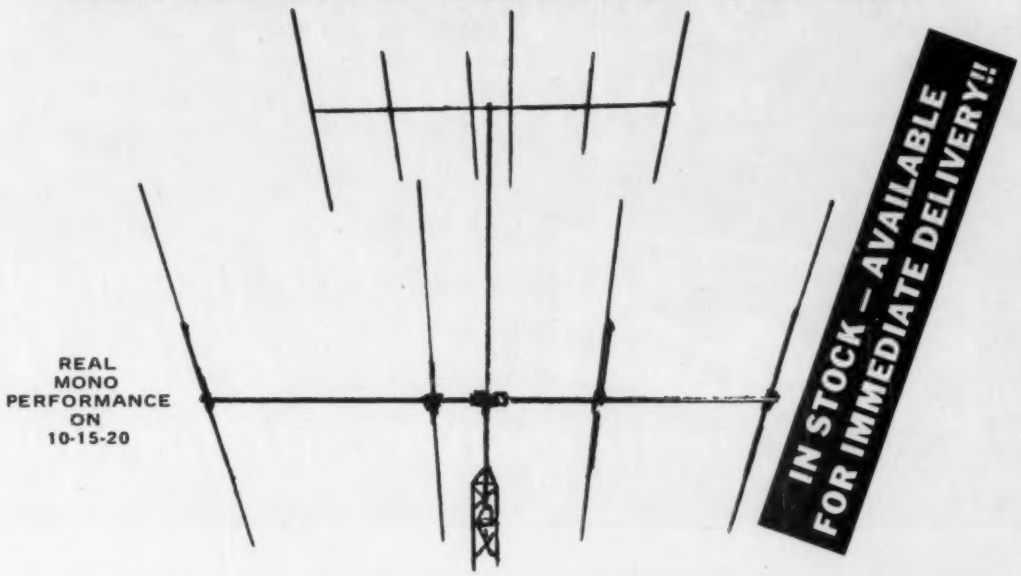

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M154	10.0	25	30	20	4	24'3"	15'9"	3.0	75	30	32	89.00
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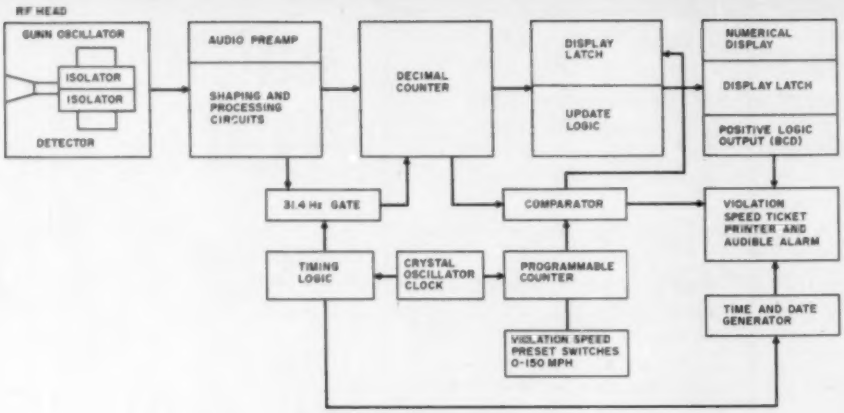

Fig. 1. Block diagram.

Stirling M. Olberg W1SNN
19 Loretta Road
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Mobile Smokey Detector

-- 10.5 GHz: use it or lose it

While a few readers may want to build this unit which is described as a smoke detector, the main reason for publishing this article is that it is an example of applying ham techniques to make commercial products. Note that, by the simple addition of a small 10.5 GHz oscillator, this unit can be used in the 10.5 GHz ham band for communications with other cars using the detector. Since power levels below 100 mW could perform well, it might not even be necessary to have a ham ticket to use this transceiver. The article certainly opens up all sorts of interesting experimental opportunities. As a detector of police radar — one which returns a strong echo modulated to indicate whatever speed you wish — it is possible that a lot of these could be sold. It could be marketed for under $50 and homemade for perhaps $10. — Ed.

Many times when I've been rolling merrily on the highway, I've come upon road signs indicating that the road was "Radar Patrolled," which I've paid little or no attention to. One day I got bagged. I saw the radar too late and, of course, it had me before I could slow down.

I was to become very closely associated with traffic radars, but at that time all I could do was pay the fine and slow down. I thought of installing one of the gadgets that detects radars, and tried one. It was a disappointment.

Some time later I was to become associated with a firm which sold and serviced police equipment, including traffic radars. I became very intimate with the workings of the beasts. Also, the methods of detecting them at reasonable distances became of greater interest to me.

Building a fairly sensitive radar detector requires an understanding of how a traffic radar works. Here is a rundown on several of the units which are in common use by traffic safety officers.

For the most part, traffic radars throughout the USA are CW Doppler radars operating in the X band region at 10.525 GHz. There are other frequencies in use, but we will confine this description to X band versions.

If a microwave oscillator producing a CW signal coupled to an appropriate antenna is pointed at a target, which is moving toward or away from the antenna, the target will reflect part of the radiated signal back to the antenna and that signal will be modulated by the motion of the target, producing a Doppler signal which is in the audio range. A detector, also connected to the same microwave antenna, will rectify the reflected signal and, when amplified by an appropriate audio amplifier, can be processed to determine the speed at which the target is moving.

Most people have experienced the Doppler effect and perhaps have not realized it. Perhaps you remember that the pitch of a railroad train horn appears to sound higher when approaching, and then seems to go to a lower pitch after it has passed. It is this audio component, produced by microwave reflection, which can be processed to tell the exact speed of a vehicle.

Since it is an audio signal, it is quite simple to calculate the frequency of the Doppler for a given speed. To calculate the Doppler frequency, we use the following formula:

$$Fr = \frac{C+V}{C-V} \times Ft$$

where
Fr = the received frequency
Ft = the transmitted frequency
C = the speed of light
V = the speed of the target
Fd = the Doppler frequency

Since we are interested in the difference between Ft and Fr or Fd, and we know that our radar transmitting frequency is 10.525 GHz or 10,525,000,000 Hzps, and that C is equal to 186,000 miles per second or 186,000 x 3600 mph, we equate as follows:

$$Fd = \frac{2V \times 10.525{,}000{,}000 \text{ (Hzps)}}{186{,}000 \times 3600 \text{ (mph)}}$$

$$Fd = \frac{2V \times 10.525 \times 109}{6696 \times 105}$$

$$Fd = \frac{2V \times 10.525 \times 104}{6696}$$

$$Fd = 2.986V \times 10.525$$

$$Fd = 31.4V$$

All this means that a target speed of one mile per hour has radio Doppler of 31.4 Hz per second. Therefore, if the speed of the vehicle is multiplied by 31.4 Hz, the Doppler frequency will be the answer (example: 31.4 x 60 mph = 1884 Hz).

The traffic radars use a diode rate counter and an integrator circuit coupled to an appropriate dc amplifier to operate a direct reading meter calibrated in mph. A digital frequency counter which is gated at 31.4 Hz will give a direct reading in miles per hour.

These radars are calibrated internally from a quartz crystal oscillator and associated dividers to produce, usually, a 60 or 65 mph direct calibration. The calibrators are checked against laboratory standards which are related to NBS accuracy. Certification is required in writing for court use and must be done at least twice a year in most states.

A look at the block diagram Fig. 1 will assist the reader in following the operation of a digital radar. The compare circuits are controlled by a programmable speed alarm which is preset by the operator to the value which has been determined to be the violation speed. The comparator digitally looks at the target speed and the preset speed and, of course, an alarm goes off if the two values are equal. The alarm sounds as an audio beep and the speed is indicated on a numerical display.

In many of the older radars, a tuning fork vibrating at 1884 Hz held in front of the antenna provided the calibration for 60 mph. Radar patrolmen were instructed not to set up near moving objects such as rotating signs or motor driven rotating devices — and there is the clue to a good radar detector.

In the older radars, two pieces of wave guide were fitted in a manner that allowed one of them to be the transmitting guide and the other to be a receiving one. A Klystron or Gunn oscillator served as the transmitter, and a detector was mounted at the end of the second guide; both sections of guide were mounted to excite a small parabolic reflector having a gain in the vicinity of 22 dB and a beamwidth in excess of eight degrees.

The more up-to-date digital units use a circular wave guide, and the antenna is a circularly polarized horn. A circular mode transducer is used to decouple the detector from the transmitter. In the conventional wave guide configuration, the two sections of the guides had a shield between them to allow only a small amount of rf from the transmitter to bias the receiving diode. Very poor control of the level was maintained; often vehicles reflected excess bias and destroyed the diode. In the circular mode, this effect is greatly reduced by the mode transducer, although destruction of the diode can still occur (from almost direct occlusion of the horn).

The output of the detector is connected to a very high gain audio preamplifier, which has a low cut at three hundred cycles and upper response at four kilocycles, allowing speeds of ten miles per hour to 130 mph to be detected. The output of the amplifier is usually shaped to a square wave and then further prepared into digital form for alarm and display. We will not concern ourselves with any of the signal processing beyond the amplifier, since all we want is an indication that a radar is present.

Recall that the tuning fork or a vehicle, or anything which is moving in the beam of the antenna, produces a Doppler at an audio rate. Suppose we construct an antenna with a detector mounted at the correct position to produce a good match, and then feed the output of the detector which has been biased by dc; instead of a Klystron to produce the best match to the input of a good low noise preamplifier, shouldn't we hear the radar? "Negatory," as the CBer says, "there ain't no Moji there."

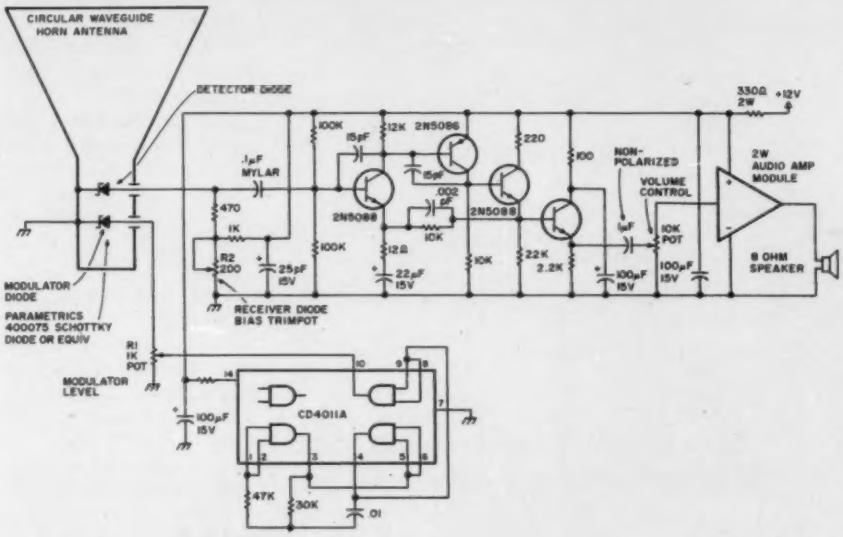

Fig. 2.

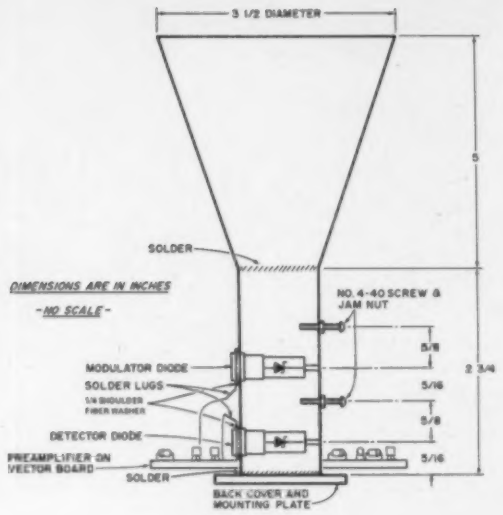

Fig. 3.

If some modulation is applied to the received signal, much greater detection range can be realized. Modulation must be applied at low levels, and at a low frequency, for two reasons. First, if the level is too high, it will leak into the audio amplifier and be a nuisance sound. And second, the rf picked up by the detector antenna reflects back to the radar when you are close to it, and a high frequency modulation rate will indicate strange things to the policeman operating the radar! So keep the modulation rate at 300 Hz, which is 9 miles per hour. Oh yes, there are laws which cover interfering with the performance of a peace officer doing his thing. You say you're not transmitting anything, of course not, but try convincing the judge!

The receiver we will construct is not new to amateurs. It's the old crystal video receiver trick or zero i-f receiver QRP fans are using. The microwave antenna, detector and modulator are simple to construct and can be made with tin shears and a soldering iron. This construction project is a guide for those who'd like to copy my unit or try to come up with a better one.

The horn is a 23 degree cone shaped from flashing copper. To make the cone mandrel, I used a four inch piece of heavy card. By rolling one end tighter than the other, a cone is formed and adjusted until it is 3-3/4 inches in diameter at the large end, and 7/8 of an inch in diameter at the other. The hole at the small end is taped over with Scotch tape, and the cone is filled with wet sand or patching plaster. Next, smooth a piece of copper flashing and roll it around the paper cone. Trim the edges so that they butt against one another. Now solder the edges together, slide the copper cone off of the mandrel, and you have a horn.

Next, provide a three inch disc of vector board. In the center of the disc bore a 7/8 inch diameter hole. This hole should be as close as possible to the outside diameter of the 3/4 inch copper pipe, to provide a tight fit.

Construct the audio amplifier on part of this board, observing all of the procedures which a high gain hi-fi preamp requires.

The audio oscillator which is used as the 300 Hz source for the modulated diode is also built upon the same disc.

All components are mounted on vector clips for both sections. Care in part orientation must be taken, to insure no coupling between the 300 Hz oscillator and the amplifier input.

The preamplifier circuit is composed of three low noise transistors. The output of the preamplifier is fed into a two Watt amplifier module which will drive a small 8 Ohm speaker.

The overall gain of the preamp/amplifier combination is great enough to have a 10 microvolt signal really make the speaker move. All wiring to externals, such as the volume control and switch, should be shielded to avoid picking up undesired radiation. This allows the detector to be absolutely silent unless it is the field of a radar or X band signal at 10.525 GHz. Voltage from the automobile cigarette lighter can be used to operate the detector.

When the amplifier has been completed and tested, lay it aside and finish the construction of the diode detector and modulator. Be very careful to position the diode mountings and the two tuning screws as shown in the drawing.

The diodes used are sold by Parametrics in Winchester, Mass. They are Schottky diodes and are very sensitive. Do not handle them unnecessarily, since they can be damaged easily. 1N23E diodes will also work fairly well, but at reduced range.

Construct the mountings for the diodes from 7/8 inch diameter brass tubing (which can be obtained from hobby shops) or use a piece of 3/4 inch water pipe. The rest of the mounting is easily constructed from shoulder washers and solder lugs. Solder the lugs to the wire connections before the diodes are installed.

The two tuning screws should be made of brass. The gain nuts can be steel. The positioning of these two screw holes should be accurate. Tap the two holes for 4-40 threads.

Next, mount the audio amplifier/modulator on the copper pipe directly behind the receiver diode. Use epoxy glue to hold it in place. Locate the amplifier input as close to the detector diode as possible to reduce its lead length. The volume control can be brought out through the rear of the coffee can, as can the power and speaker cord. Solder the two inch square of 1/16 thick brass over the end of the pipe.

Prior to final assembly, the tune-up procedure for maximizing the sensitivity of the "smoke" detector should be done as follows:

An X band signal generator and an ac voltmeter are required. The signal generator should be connected to a gain standard horn which is located about 5 feet away from the radar detector horn. Clamp this horn so that it is stationary and directed into the radar detector horn.

Next, connect a VOM in an ac mode to the speaker terminals; set the meter to read 8-10 volts full scale.

Turn the pot modulator trimpot R1 to 50 percent of its rotation, turn the volume control full on, and turn R2 to full counterclockwise. Be sure R2 is at the ground end. This pot sets the dc bias on the receiving diode.

Turn on the signal generator and set it to 10.525 GHz; turn the output attenuator to allow full output to feed the gain standard horn.

Now turn on the radar detector. A 300 cycle tone should be heard loudly. Adjust the volume control to produce 1 volt on the VOM. Check the orientation of the antennas to be sure that they are aligned for maximum signal, and rotate the circular horn about its axis to be sure of maximum signal.

Secure the radar detector so that it will not move while being further adjusted. Be sure you have access to the two tuning screws.

Next, adjust R2 until +.125 millivolts dc appears at the output of the detector diode. A slight increase in

output signal will be noted on the VOM. Carefully adjust R2 in very small increments, until no further increase in signal output is noted on the VOM. Now adjust tuning screw A until an increase in signal is indicated on the VOM. This screw will adjust through a peak and will be erratic if the gain nut is loose. Make it tight to allow the screw to move with a heavy drag on it. Once the peak is reached, move to the second screw B and adjust it in the same manner as screw A was adjusted. Further adjustment alternately of the A and B screws can be made until no further improvement is noted. The last adjustment is touching up R2 to see if a slight increase can be observed.

Decrease the signal level by turning the attenuator to 70-75 dBm and then change the VOM scale to read 1 volt full scale. Approximately 800 millivolts of signal will be indicated. This is about the maximum sensitivity with this receiver, and should allow detection of radars within a range of at least 2500 feet when in a straight line with the radar antenna. Radars can be heard at distances of one mile or greater, which should give adequate forewarning. The unit can now be assembled into the coffee can. The two inch square brass plate serves as a mounting, which is fastened to the rear of the coffee can. The plastic cover which comes with the can acts as a cover radome.

Now that you can easily detect radars, don't push your luck; use the detector to help stay within the legal speed limit. Radar is used to help keep you alive. The mobile smoke detector will help, and not cheat, "Smokey the Bear" when you keep this in mind. Those who choose to notify other "ears" that "Smokey" is around may find that it makes the old bear happy when they do. ■

Get a Kid Off the Streets

-- and into ham radio

Gabe Gargiulo WA1GFJ
17 Whitney St.
East Hartford CT 06118

Suggestions for ways that we hams can keep ham radio alive have appeared from time to time in this magazine. There is one way, however, that I don't remember seeing in print. That is *giving ham radio books to your local library*.

I realized how important this could be a few years ago when I gave a few of my old ham radio books to the North Haven, Conn., library. The librarian called me to thank me, and said that *they get a lot of requests for this type of book, mostly by young people*. Since that time I have lost count of the number of books I have given to the libraries in Hartford, East Hartford and North Haven.

Look around your ham shack. Aren't there at least a few books of yours that you don't read anymore, that you haven't needed in years? Don't you have an old callbook, ARRL license guide or *73* study guide?

Honestly, do you think you really need these books? Have you ever lent them to anyone? Probably not. So all these years these perfectly good books have been doing no one any good. What a shame! Some high school student might have picked up the book and gotten started in ham radio.

What's your objection? You think you might need the book some day? That's possible. Then you can go down to the library and borrow it back. Can't afford it? I think you can't afford not to do it. Your few dollars are an investment in the future of ham radio. The more people there are in ham radio, the more chance there is we won't be clobbered in the next WARC.

If you don't have any books gathering dust, then why not buy a few? *73* puts out some excellent books and study guides. The *ARRL Handbook* isn't too bad either. Spend a few dollars to get some kid off the streets and into ham radio.

And now for the ultimate – an absolutely terrific way to get people interested in ham radio. Buy a subscription to *73* for your local library! Far out? Not at all. The Hartford Library already carries *QST*. *73* is by far more exciting. Put *73* on the shelves of your library. I'll bet it will be worn out and dog-eared in a week.

I'm going to practice what I preach. As I'm writing this, I am taking down a copy of the ARRL VHF manual and will drop it off at the North Haven Library in an hour or two. Let's see, there are a couple of boxes of books in the attic. I wonder if . . . ■

73 Magazine Staff

Add RIT to Your Transceiver

-- a must for CW operators

It is quite interesting to note that many new transceivers are still coming on the market without incorporating RIT, or receiver incremental tuning. Of course, if you purchase the accessory vfo most transceiver manufacturers make, you don't need RIT and will have more tuning flexibility than with just RIT. But for many portable and mobile applications, the idea of adding another box to the basic transceiver is awkward.

What is RIT? Most amateurs are familiar with RIT, so just a brief background summary for newcomers. Transceivers which transmit and receive on exactly the same frequency (because of a common master oscillator) work fine with each other as long as one does not change the receiver tuning once contact is established to get a better audio response, different CW note, etc. If this is done, the transmitter frequency is changed and the other party will retune his transceiver when you transmit, etc. The cycle is repeated each time one party transmits and the overall result is so-called "leap-frogging" up or down a band and in some cases maybe straight out of a legal band segment for the mode being used! The cure is simple: Provide a means for tuning the transceiver in the receive mode over a small (incremental) range of a few kHz without affecting the output frequency of the transceiver in the transmit mode. One also has to (or should) provide some means to disable the RIT so receive and transmit frequencies correspond exactly when desired to initiate a contact.

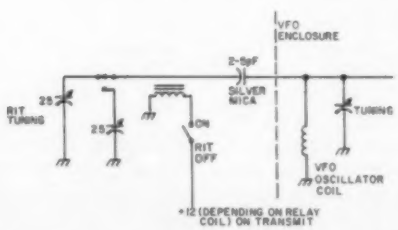

Fig. 1. RIT circuit using regular air variable capacitors.

Basic RIT Circuit

The basic RIT circuit is shown in Fig. 1. This was the usual way incremental tuning was added to transceivers for several years until solid state devices came on the market. But it shouldn't be dismissed too easily. It still has applications and may be the best way to add incremental tuning even to solid state transceivers! Besides simplicity, it also has an outstanding feature in that air variable capacitors are used and only one silver mica. They have excellent temperature stability and produce a minimum effect on the basic temperature and mechanical stability of the transceiver's vfo.

The circuit functions by switching one of the two added variable capacitors across the tank circuit of the vfo. In the transmit mode a capacitor is switched in, which is set at about ½ its capacitance range and which is not panel mounted. In the receive mode, another capacitor of the same type which is panel mounted is switched. When this capacitor is set to exactly the same value as the other capacitor, receive and transmit frequencies correspond. When it is varied, the receive frequency can be varied plus or minus a few kHz without changing the transmit frequency. The first capacitor is made variable instead of fixed because small differences in wiring capacitance will invariably exist and having it variable allows the second panel mounted capacitor to be set at exactly mid-range to achieve equal receive/transmit frequencies. A switch can be provided in the relay coil

circuit to disable the relay and then, of course, the receive/transmit frequencies will have to remain the same.

The variable capacitor values shown in Fig. 1 are typical for use with most HF vfo circuits. A good clue as to what value to use is to check the size of the variable capacitor used for the usual "frequency adjustment" or "dial set" capacitor on the vfo. Use about the same value. Some readjustment of the vfo calibration is necessary after adding RIT, but since this is true for the solid state circuits also, it is discussed at the end of the article.

Solid State Variations

The action shown in Fig. 1 can be duplicated by a variety of transistor and diode circuits. They have great value when mechanical considerations do not allow the placing of the capacitors necessary for RIT right next to the transceiver vfo. Only the transistors or diodes providing the variable capacitance effect, plus their isolating resistor or rf choke, need be placed right at the vfo tank circuit. Their dc control leads can be run to a tuning potentiometer located at any convenient point on the transceiver panel. One good method to "free" a pot location on the front panel and avoid drilling holes is to gang-up two existing separate front panel controls (such as af and rf gain) into one dual pot with concentric shafts. Many TV replacement pots are usable for this purpose.

Fig. 2 shows an almost completely solid state RIT arrangement. A relay is still used to switch control potentials to the varactor diode, but since the relay only carries low voltage dc instead of rf, almost any simple relay will suffice. If a transmit/receive relay in a transceiver should have a set of unused contacts, they can be used to do the necessary switching. Of course, then there would be no possibility of disabling the relay to provide for exact coincidence of receive and transmit frequencies. The varactor tuning pot would have to be set at the point of zero frequency offset to accomplish this.

In the receive position of the relay, a fixed bias is applied to the varactor diode by means of the 10k Ohm divider network. In the transmit position, a variable bias is applied by the 10k tuning pot. Only one pot (the 10k tuning pot) is front panel mounted, but a number of adjustment pots are provided in the circuit for flexibility in adjustment. To start, adjust the 10k pot R1 so the voltage on the diode is about half of the supply voltage. Adjust R3, R5 and R6 to maximum resistance. Place the control knob on R4 at its mid-point (12 o'clock). Adjust R3 and R5 in the receive mode so the voltage on the diode is exactly the same as in the transmit mode. Rotate R4 both sides of its center position and check that the frequency excursion is about the same on both sides. If not, "linearizing" pot R6 is adjusted so it comes as close as possible.

The total frequency excursion of the RIT depends on a number of factors but is controlled to a large degree by the settings of R3 and R5. If these pots are set at their maximum values, the voltage excursion possible by R4 is limited and the RIT range

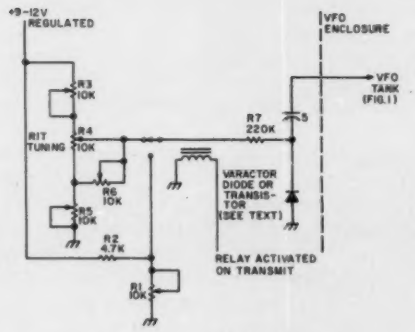

Fig. 2. Solid state version of RIT.

restricted. The opposite is true with these pots at their minimum values. In a typical case, the RIT can be set for excursion of from ± 1.5 kHz to ± 10 kHz. Which setting to use depends on one's taste. Try the minimum range first (procedure as described) and work up to a wider range if it is found necessary in actual operation. There may seem to be a lot of pots in the circuit but they are there because of adjustment flexibility and because of price. R4 is a standard single-turn, linear-taper, panel mounted pot. All other pots are 15 turn trimmer pots. These pots are highly recommended because they provide very fine adjustment and can be obtained from Poly Paks, Lynn MA (see almost any *73* issue for ad and address) at a bargain price of 2/$1.00.

A word about the other components. The varactor diodes can be obtained for about $1.00 each from Circuit Specialists, Box 3047, Scottsdale AZ 85257. Their free catalog has a nice graph of the capacitance range of the various diodes they offer. Some transistors can also be substituted for varactor diodes and work quite well by utilizing their collector-base capacitance change with applied voltage. Try 2N697, 2N2053 and 2N3053. The emitter is left floating. Base goes to ground and the collector is the other end of the "diode." R1 should provide sufficient isolation for the diode. If, however, the circuit should seem to be "touchy" and not rf isolated, try a few ferrite beads over the diode end of R1. The only leads that must be kept short and well dressed are those for the diode, C1, and the end of R1 going to the diode.

Fig. 3 shows a few variations for solid state RIT circuits. In Fig. 3a, the relay has been omitted since many transceivers provide low voltages in the receive or transmit modes already switched on or off by the transceiver circuitry. The power diodes are used for

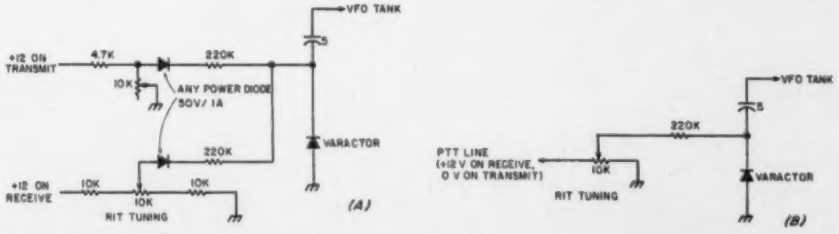

Fig. 3. Simpler RIT circuits. (a) Shows circuit particularly suited to solid state transceiver. (b) Shows a crude but usable RIT.

isolation so that the inactive voltage circuit does not interfere with the active one. Fig. 3b shows about as simple a RIT circuit as one can develop, but it does have disadvantages. The zero frequency offset position on the tuning potentiometer cannot be adjusted and the frequency offset will be non-linear as the tuning pot is varied. Nonetheless, just to give a quick and inexpensive try to RIT, it is worthwhile remembering.

VFO Realignment

Adding RIT to a vfo places some additional capacitance across the tank circuit of the vfo which must be compensated for. One may be inclined to compensate for the added capacitance by readjustment of the "dial adjust" or "frequency adjust" control on a tranceiver in conjunction with a calibrator. Doing this would, however, destroy the usefulness of this control since it would have to be set at the extreme end of its adjustment range and probably will not have sufficient range left to perform its normal function.

One has to adjust the slug in the oscillator coil or internal padding capacitor to bring the oscillator frequency and dial calibration back into alignment. Disconnect the RIT circuitry and note where calibration zero beat occurred on the dial. Reconnect the RIT circuitry and tune the coil slug or padder capacitor until zero beat is re-established. The amount by which the slug or capacitor has to be turned should be very small – usually a fraction of a turn. This small adjustment should not effect the linearity of any oscillator. Check this by being sure that the calibration zero beat at each extreme of the tuning dial is still achievable within the range of the "dial set" or "frequency adjustment" capacitor on the vfo. ■

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Coronaries for Burglars

-- with this cheapo car alarm

Theft of radio gear from parked cars is on the increase nationwide. While there have been no local reports of such losses lately, the threat is always there. One way of protecting yourself against such misdeeds is to install a car burglar alarm.

To be sure, alarms aren't foolproof, and at best can only be expected to frighten off a would-be thief. Still, some protection is better than none, and the burglar alarm approach is probably the most cost-effective.

While commercial alarms are available, they generally aren't cheap, and besides deprive the true experimenter of his bent to improvise. An amateur's solution to the need for a burglar alarm is shown in Fig. 1. This simple circuit requires only three parts and some wire, but does its job extremely well. The alarm is activated whenever one of the car doors is opened, and is effected by intermittent blasts of the car horn which continue until the alarm is manually reset.

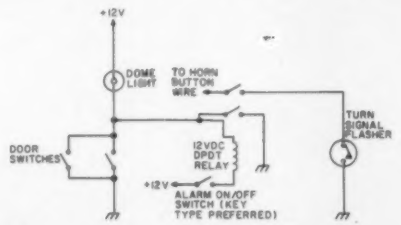

Fig. 1.

The alarm basically consists of a 12 volt relay which is connected to latch in the closed position whenever the dome light circuit is completed (by opening a door). Closing the relay also returns the horn relay line to ground through a turn signal flasher, which will alternately make and break the circuit, providing repeated blasts on the horn. Once the relay has latched, blowing of the horn will continue until power is removed by opening the alarm switch. Note: The alarm switch must be located *outside* the car in order to set the circuit when parking. If a toggle switch is used, it should be placed in a hidden location. Otherwise, use a key switch. ■

Reprinted from the March, 1975, *Key-Klix,* Journal of the Santa Barbara Amateur Radio Club.

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Power Supply

-- versatile

This article describes what I call a versatile regulated power supply. Versatile because of its many uses: a 12 volt version powers my Drake TR22, another powers my Regency HR220. A 5 volt version runs the logic in the WR4AKK repeater, while one with plus and minus 15 volts powers all my op amp projects.

All in all, I've built nine power supplies of different voltage and current ratings using this circuit.

Whether you need a supply to charge batteries, run a portable tape recorder or radio, operate relays, run your mobile FM rig in the house, or power op amps or logic, this circuit definitely deserves a try. It's simple, uses a minimum of easily obtainable parts and, best yet, it works.

The basic circuit (Fig. 1) is a simple two transistor regulated supply. One transistor, Q1, acts as a reference voltage source and the other, Q2, acts as a series pass regulating element.

The circuit is the same no matter what the output voltage. Only the transformer, zener diode, resistor R2, and possibly Q1 and Q2 have different values.

Circuit Theory

The circuit consists of three sections — the transformer, rectifier and filter being one, the voltage reference another and the series pass regulator transistor the third.

Pick your transformer for a slightly higher voltage than you wish to regulate. For example: for 12 volts regulated output, use a 16 to 19 volt transformer (a 6 volt and a 12 volt filament transformer in series). For 5 volts regulated output, a 6 V filament transformer is used. And for 15 volts output, use a 24 volt transformer.

If you use a transformer capable of high current output, you may need to put a resistor in series with the output of the rectifier. This prevents the surge current, generated when the supply is turned on, from destroying the rectifier diodes.

Of all the different rectifier circuits in use today, I prefer to use the full wave bridge. The bridge circuit has a higher output voltage than the standard full wave rectifier and a higher frequency ripple than the half wave, making it easier to filter. However, any type rectifier, as well as the conventional voltage doublers and triplers, can be used with no circuit degradation.

For output filtering, I have found that using a 1000 uF capacitor for C1 provides adequate filtering. The more capacitance, the more filtering, so you can increase this value if you wish. The regulator also acts as a capacitance multiplier so that the total capacitance is the capacitance of C1 plus the capacitance of C2 multiplied by the gain, h_{fe}, of Q2:

$$C_T = C_2 (h_{fe}) + C_1$$

Resistor R2, the zener diode and Q1 form a voltage reference circuit. Set the reference voltage to about 1.5 V above the desired output voltage. The reference voltage is higher because there are two diode voltage drops between this point and the output. To determine the value of the zener current limiting resistor, R2, you must first know the gain of transistors Q1 and Q2.

The dc gain of Q1 and Q2 can be found in a transistor specification manual. Gain, sometimes called Beta or h_{fe}, is the ratio of the collector current to the base current that caused it. For example: for a transistor with a gain of 20, 1 mA of base current causes 20 mA of collector current.

Now, knowing the transistor gains and the desired output current, you pick a value for R2 by calculating how much current must flow from the base of Q1 to make a corresponding amount of current flow from the base of

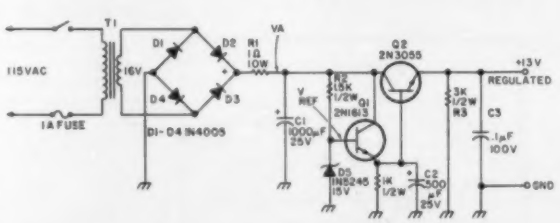

Fig. 1. Regulated +13 volts at 2 Amps using NPN transistors.

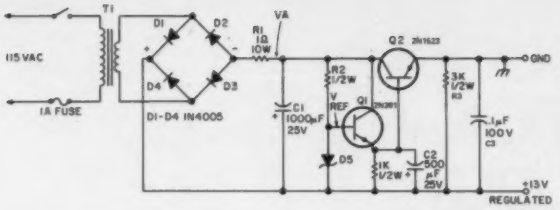

Fig. 2. Regulated +13 volts at 2 Amps using PNP transistors.

Q2, to cause the desired output current flow into Q2. Simple. Right?

For example, we wish to have a regulated output voltage of 13 V at 2.0 Amps. The gain of Q1 is 70 and the gain of Q2 is 20. The voltage at point A is 20 V. To cause 2.0 Amps of current to flow into Q2, the current flow from the base of Q2 must be 100 mA.

$$I_b = \frac{I\ out}{gain} = \frac{2.0\ A}{20} = 100\ mA$$

And similarly, to cause 100 mA of current flow into Q1, the base current must be

$$I_b = \frac{100\ mA}{70} = 1.4\ mA$$

If you use a 15 V zener diode, the voltage drop across R2 is 5 V, so from Ohm's Law:

$$R = \frac{E}{I} = 5\ V/1.4\ mA = 3.7k$$

Let R2 be 3.3k. The reason for this lower resistance is that most transistors have less gain than that listed in the specification book, so by using a smaller resistor more current will be available, making up for possible low transistor gain. This also gives you a safety margin, in case you need just a bit more current than you thought.

In picking transistors for Q1 and Q2, not only must you pick a transistor with suitable gain but you must also choose it for its type (NPN or PNP), emitter-collector breakdown voltage (BV_{ceo}), collector current (I_C), and power dissipation.

All of these circuits use NPN transistors. If you wish to use PNPs, reverse the polarity of the rectifier output, the filter capacitors and the zener diode. Isolate everything from ground. If you require that the negative lead be grounded, ground the emitter of Q2 (see Fig. 2).

BV_{ceo} is the voltage at which the collector to emitter junction breaks down. For Q1 this voltage rating must be high enough to stand the difference in voltage between the rectifier output and ground, and for Q2 the rectifier output and the regulated output.

The collector current (I_C) rating of each transistor is the maximum continuous collector current that the collector to emitter junction can safely pass. For Q2, this is the total output current which you require from the supply.

Power dissipation is the maximum amount of power that the transistor can dissipate before it is destroyed. The power dissipation rating is usually given for an ambient case temperature of +25° C. If you heat sink the transistor (which I recommend for Q2), you can exceed this dissipation by an amount which depends upon how well your heat sink dissipates the power.

The output circuit consists of R3, a bleeder resistor chosen to allow a couple of milliamps of current to flow, and capacitor C3, which acts as a high frequency filter to keep any zener noise or voltage spikes out of solid state equipment.

Construction

The circuit layout is not critical and almost any type of configuration can be used. I have built the supply both on a piece of pegboard with the device leads serving as hookup wire, and on a printed circuit board. With the circuit board shown in Fig. 3, the electrolytic capacitors are mounted external to the board due to their large physical size. This figure also shows Q2 mounted on the board. While this will work for low power applications (one example is the supply running my TR22), I would suggest that you heat sink this transistor, as it does pass the total load current and can get warm.

You will notice that there is a break in the land coming from the positive output of the bridge. This is where R1, which must be heat sinked externally from the board, is connected. If you do not use R1, connect a jumper in its place.

I used a resist marking pen to draw the circuit on a PC board. You can do the same or make a photographic negative and use the photoresist method of making a board. The board in Fig. 3 is shown full size. I have mounted all of my supplies inside Bud boxes, and, as there are quite a variety of Bud boxes, no two supplies look alike. The only precaution is to mount the heat sinked transistor, Q2, where its case cannot be accidentally shorted to ground. If possible, mounting it on an attachable heat sink and mounting the heat sink inside the box (with a few ventilation holes) will work fine. I have not included any pictures of box layouts, as that is a matter of personal choice and the requirements of the equipment you need the supply for. ■

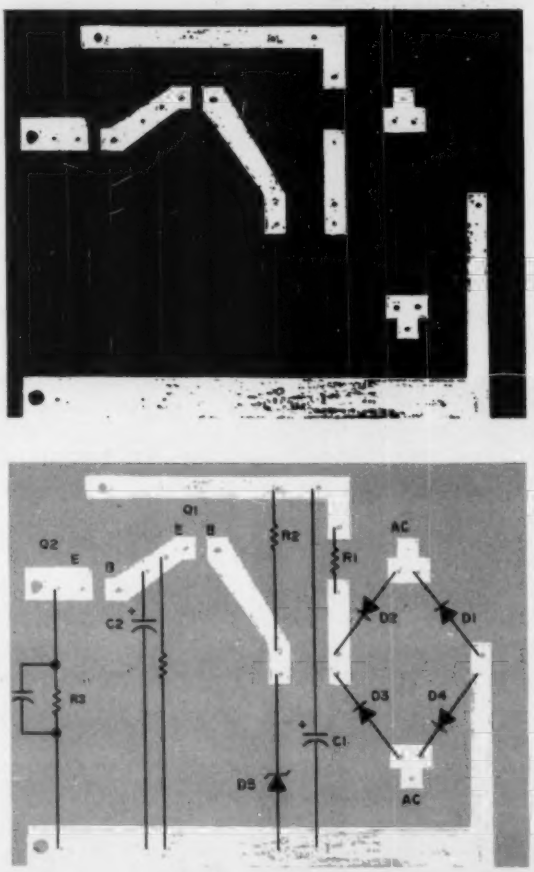

Fig. 3. Foil side view.

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	**SSB (A3J), CW (A1)*
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Size (mm)	*90H x 155W x 235D*
Weight (kg)	*2.7*
TRANSMITTER	
TX Output	*F3 10W*
	**A3J 10W (PEP), A1 10W*
Carrier Suppression	*40 dB or better*
Spurious Radiation	*−60 dB or less below carrier*
Maximum Frequency Deviation	*±5 KHz*
Microphone Impedance	*600 ohms*
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Sensitivity	**A3J, A1 0.5 microvolt input gives 10 dB S+N/N or better F3 0.6 microvolt or less for 20 dB quieting S+N+D/N at 1 microvolt input, 30 dB*
Squelch Threshold	*−8 dB or less (F3)*
Spurious Response	*−60 dB or better*
SYNTHESIZER:	
Frequency Range	*144 MHz to 148 MHz*
Step Size	*5 KHz for FM*
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Also, included is the circuitry which makes the 100 Hz steps possible with a 10 KHz reference. This circuitry is so unique ICOM has a Japanese patent pending.

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DXpedition: Memories for a Lifetime

- - reflections of HK1TL

To those of you who have never been a part of a "FIRST," I must tell you that the feeling is one beyond description.

Maybe you could compare it with the thrill of your first amateur contact. Do you remember it? Do you remember the adrenalin flow? If you made the first contact on CW as a Novice, did your mind go blank when it was your turn to transmit?

Well, that is an inadequate description, but it is the best that I can do. HK1TL was the callsign of the Pack Rat Colombian Moonbounce Expedition, an expedition designed to accomplish the first 432 MHz EME contact from the continent of South America. It was, as you no doubt have already read in the press releases, a complete success.

Who are we? How did we get there? Why did we do it? Would we do it again? What did we learn? What were the people like? How long did it take to plan?

It is now two months since the history-making event. I have been asked to put together reflections of the expedition.

Well, let us start with basic definitions that may help you understand what the Pack Rats are and what motivates them.

The Pack Rats are officially the Mount Airy VHF Radio Club. We are now 20 years old. Our main purpose is to promote interest and activity on the VHF bands, and improvement in operation and equipment. All club members are expected to participate in the club-sponsored activities: club nets, meetings, January VHF sweepstakes, June VHF QSO party, and our annual flea market "Hamarama."

We are not what one would call a "DXpedition Club." As a matter of fact, prior to HK1TL, there were only two other expeditions that I know of. An attempt to break the 1296 MHz record over water from Rodantha, N.C., in the summer of 1970 failed. A 1296 MHz expedition to the state of Delaware was a success.

HK1TL, our third expedition-type operation, entered the planning stages in January, 1976. We discovered a potential new member who was originally from Colombia. He made contacts with his friends in Barranquilla, Colombia, and we started through the red tape necessary to get all the approvals. My correspondence file is more than 2 inches thick but that is the nature of dealing with governments.

Why did we do it?

Because it needed doing, because we had the opportunity, because we had the expertise to do it, and because we were assured of complete cooperation from the Colombians.

Would we do it again?

Well, obviously if something was a success, you have no reservations about doing it again. However, knowing what we know now, we would have been better prepared for power outages. We would have insisted on a 4 kW generator with adequate regulation.

We learned that you can always count on amateur radio cooperation: from the equipment handling of Russ Wicker W4ZXI through the Miami Airport, the Area 2 Radio Club in Barranquilla, the 20 meter liaison work of W3KKN and W3TNP Ernie and Bertha Kenas, as well as the operation of the Pack Rat Moonbounce station W3CCX/3 by Dave Mascara WA3JUF. Everybody wanted it to work.

We also learned quite a bit about the effect of Faraday shift. That is to be the subject of a separate article.

We learned that the pressure of six months of intense preparation ran us to the breaking point, that at times we would have petty arguments among ourselves. Fortunately, there was always someone wise enough to sit back and analyze the situation. Tempers were getting short; pressure was building. "Hey, you guys, let's not let the situation get out of control."

Finally, what were the people like?

"Super" is the best description I can offer. They couldn't do enough to help us. Not only the Colombian hams, but the farm people and the civil defense organization. I would not have thought it possible in two short weeks to establish such deep personal relationships, but we did.

What kind of problems did we have?

In addition to sporadic, if any, line voltage, we discovered on unpacking that a filter capacitor in the power supply had broken loose from its mounting. That is not so bad, but it rubbed against a chassis corner and tore a hole in it. We requested another from the states and in the meantime set about to effect repairs.

Some solder closed up the hole and we were lucky it worked. We were also unfortunate enough to blow our 2 meter transistorized converter during the second OSCAR run. More field repairs required.

Any idea how you solder with the electricity off? Use a mini-torch (we brought one with us).

Since this was only to be an article on reflections, I'll not go into the technical decisions that were made as we prepared for the project. That will be the subject of a separate article.

Suffice it to say that if you ever have the chance to become part of a "DXpedition," do it.

Don't worry about the fact that (a) you can't afford it, (b) your XYL might go to divorce court, (c) the expedition might not be successful, or (d) that there will be a lot of work that must be done before you leave.

Do it; do it because it is a once in a lifetime experience that you will never forget. ■

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Secret PC Layout Method

- - simple and inexpensive artwork

The most desired state of the art method of making a printed circuit board is the photo-etching process. I will attempt to describe an inexpensive method of artwork that can be used to obtain professional results.

A modest supply of circles, squares, pads, fillets, line tapes, etc., can consume a large portion of a limited budget. Like many other experimenters, I would like to use these artwork aids; however, I have more time than money.

The general layout of the artwork is the most difficult portion of any etching process. If there are any simple secret methods of doing this, they certainly have remained a secret.

I suppose that most of us have a preferred way to lay out the artwork. For those who don't, I will share my secret method and a general description of my preferred way of doing the artwork. The circuit is made in its neatest form, all parts numbered, and generally reading from left to right. Of course, check and recheck.

I have developed this method for the laying out of the artwork. For the lack of a better title, let us call it the quad method. Fig. 1(a) shows a 14 pin IC laid out in a quad pattern. In Fig. 1(b), the quad sections are labeled.

Inside 1-7 means that the lead will terminate on a pin from 1 to 7 and will run between the two rows of pins of the IC. Outside means that the leads will run on the outside of the 2 rows of pins of the IC.

Figs. 2(a), (b), and (c) demonstrate the basic idea. A typical quad method of layout is shown in Fig. 2(a). Leads must follow three general rules. One, the number of inside leads must be limited. Two, there must not be leads between two adjacent pins, although I have seen this done. Three, the leads must not cross each other; use jumpers where necessary.

It can be seen in Fig. 2(b) that pin 14 is fenced in. This resulted by not following the quad method for lead "D." Fig. 2(c) is correct, as lead "D" approaches from the inside of pin 13 and exits to the outside of pin 13, going down and entering pin 6 from the inside. Following the quad method, the result is that both pin 7 and pin 14 are unobstructed as laid out in Fig. 2(a).

When wiring more than one IC, the vertical leads on the left side of the drawing will normally be the top leads, and those on the right will be run across the bottom. Whatever the case as the leads enter the quad zone of the proper IC, the leads should then run within the quad arrangement. See Figs. 3(a), (b), and (c), and note that in the finished layout the outside lead was rearranged. I might add that Figs. 3(a), (b), and (c) are actual working drawings of another project. The PC board is to be double-sided. The jumpers will be printed on the top

Fig. 1(a).

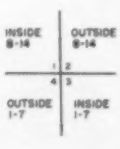

Fig. 1(b).

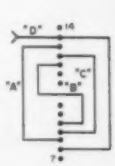

Fig. 2(a).

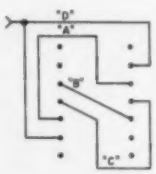

Fig. 2(b). Incorrect.

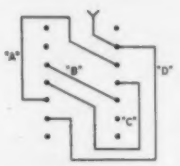

Fig. 2(c). Correct.

side, along with the power leads.

The use of a #2 pencil and a good eraser is most important, as it will be necessary to change the routing of the leads to get the best result.

After transferring the quad information to the layout on a grid paper, and finding yourself happy with the layout, place a piece of carbon paper upside down under the grid paper. The leads are now traced, leaving a carbon copy on the back side of the grid paper. This is the foil side view. On the top of a piece of corrugated cardboard or a piece of foam plastic, place a good grade sheet of white paper and tape the corners. The grid sheet is placed over the white paper foil side up, and taped at the corners to maintain registration. A hat pin or some other sharp pointed object is pressed through each place where we intend to drill the PC board. These pin holes become the centers of our dots.

The white paper is removed and put on a flat surface. A circle template of the desired size of our dot is centered over each hole, one at a time. A black felt tip pen is used to trace the circle of the template, and filled in while the template is in place. Most templates are for pencil use, so to prevent fuzzy edges the template is slightly raised above the paper by placing a couple strips of masking tape

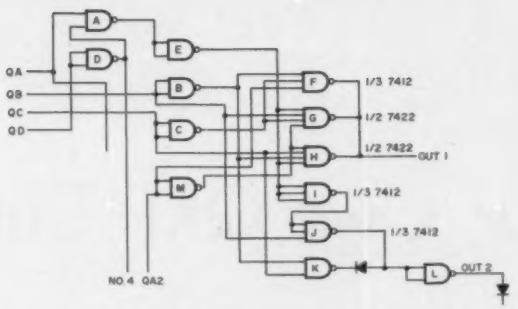

Fig. 3(a). All 2 input NAND gates are 7400s.

across the bottom side of the template. After all of the dots are made, the lines are drawn in either freehand or with a guide. A light blue pencil can be used to sketch in the lines first (if desired); this will help to prevent errors. The blue will not photograph, so if you would like to make notes on the artwork, go ahead.

For appearance, sharp corners and abrupt intersections should be avoided. This is why I prefer a sweeping freehand line. The dots can now be made into tear drops, fillets added to intersections, dots combined into double dot configurations, etc.

Check and recheck the artwork. A mistake can easily be corrected by the use of self-sticking address labels cut to fit over the area to be changed and then redrawn. After reassuring yourself that everything is correct, use the hat pin again to make sure that all holes are open.

A somewhat simpler method is the use of a light blue lined grid paper and a light blue pencil. The drawing of the foil side is drawn with the blue pencil on the blue grid paper. The final results are traced with a black felt tip pen. The hat pin is used as before to make the center of the dots.

A final personal touch is the adding of your monogram.

The artwork is now ready for the photographer, and should be copied against a white background.

Although I have always made my design double scale, it can be done 1:1 with good results. For an extremely complex drawing, perhaps a 4:1 scale would be used.

I was quite shocked when I saw a student press the pins of an IC through a piece of blue lined notebook paper. He proceeded to circle the resulting holes and to draw in the connecting lines with a black felt tip pen. To my surprise, the PC board was

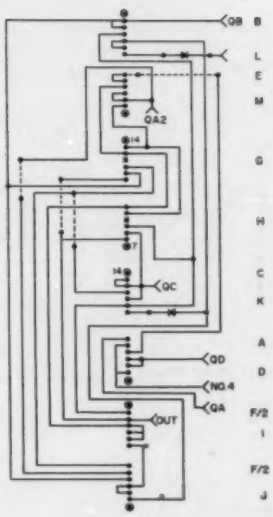

Fig. 3(b). Quad layout.

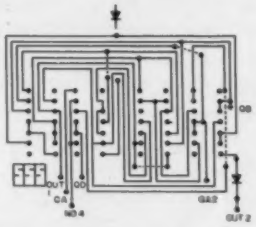

Fig. 3(c). Foil work sheet (top view, bottom foil).

amazingly nice.

The artwork may perhaps be copied with a camera as simple as the "pin hole" camera, but a high contrast type of film should be used (such as a process film and high contrast D11 developer).

Good luck on your next PC board. ■

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Ian MacFarlane WA1SNG
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Design Your Own QRP Dummy Load

- - useful beginner's project

A dummy load can prove to be a handy little gadget when it comes time to tweak-up the final in your handie talkie, QRP rig, or even (egad!) CB set. Unfortunately, there doesn't seem to be anything on the market that lends itself to the task, unless you're willing to invest in an expensive kilowatt model. The only way to get around it is to build your own, an easy accomplishment with a little forethought and a handful of components.

Dummy Loads Using Standard 5%, 2 W Resistors

Watts	R_{char}	R_{each}	N
4	50.0	100	2
4	75.0	150	2
6	50.0	150	3
6	73.3	220	3
8	50.0	200	4
8	75.0	300	4
10	48.0	240	5
12	50.0	300	6
12	73.3	430	6
14	51.4	360	7
14	72.8	510	7
16	48.7	390	8
16	77.5	620	8
18	52.2	470	9
18	75.5	680	9
20	51.0	510	10
20	75.0	750	10
22	74.5	820	11
24	51.6	620	12
24	75.8	910	12
26	52.3	680	13
26	73.3	1100	13
30	50.0	750	15
32	51.2	820	16
32	75.0	1200	16
34	76.4	1300	17
36	50.5	910	18
40	50.0	1000	20
40	75.0	1500	20

Table 1. The above design values will not result in a mismatch greater than 1.1:1, even when the tolerance is worst case.

Choosing the Resistors

Ideally, the resistors in a dummy load should act purely resistive (no reactance) over the frequency range they are going to be used. The only inexpensive resistors that come close to meeting this requirement are the carbon (composition) type. Wirewound resistors, although cheaper and available in higher wattage values, exhibit too much inductance and are bothered by the skin effect. By contrast, carbon resistors are less subject to skin effect problems, so their resistance stays fairly constant as the operating frequency increases. In carbon resistors, reactance is mainly due to inductive effects in the leads and stray capacitance between the leads and nearby metal. These effects remain negligible up to around 100 MHz providing that the resistors are properly mounted and have values greater than 25 Ohms.

Proper mounting dictates that leads should be kept as short as practical, and that there should be some separation between adjacent resistors.

Design

Because carbon resistors capable of handling more than two Watts are expensive and difficult to locate, the only convenient way to achieve high power dissipation is to use several resistors in parallel. This increases reactive effects, but it offers greater power dissipation as an acceptable trade-off, unless you need an extremely accurate dummy load. Also, it should be remembered that the power rating of resistors is a continuous "free air" rating, so for short duty cycles, a dummy load can easily stand more. For example, with the 33% duty cycle of SSB the power rating may safely be increased by three, while the 50% CW duty cycle will allow an increase of two. A good rule to follow is to touch the resistors occasionally. If they are too hot to handle then they are dissipating too much.

The actual design of the dummy load is accomplished by starting with two parameters, the desired total power dissipation and the desired characteristic resistance. Assuming that all resistors have the same values and power ratings, the following equations may be used for designing a multiple-resistor dummy load: Number of resistors needed = Desired power dissipation of dummy load / Power rating of each resistor, and Value of each resistor = Total resistance of dummy load x Number of resistors needed. All too often the calculated value for each resistor will not be a standard resistance, a factor that will complicate matters. Table 1 helps to sneak around this problem by offering values based on the standard two Watt resistors.

Construction

The actual construction depends upon the number of resistors that the above equation tells you are needed. If you can get away with just one, whether it be a 1/8 or 2 Watt, then the design in Fig. 1(a) should do the job. Here, the resistor is soldered inside a PL-259 connect, with a small metal plate soldered to the end as a shield.

For higher power operation, the circuit in Fig. 1(b) allows compact mounting for twenty resistors or more. In this circuit, two copper or brass plates are used for mounting to eliminate capacitive coupling between adjacent leads. After the SO-239 connector has been mounted, a series of small holes are drilled in both plates for the resistors. A hole is also drilled in the center of the back plate and a wire soldered between the center conductor of the coax connector and the back plate itself. As always, leads should be kept

as short as possible.

If shielding is what you need, and even higher power dissipation, then the circuit in Fig. 1(c) may be installed inside a pint or one half pint paint can. Transformer oil can be added to increase the short duration power handling capacity by a factor of three or four. A note of caution however: Don't use motor oil — because of its lower boiling point, it has a nasty habit of blowing off can lids, and sending hot oil all over the place.

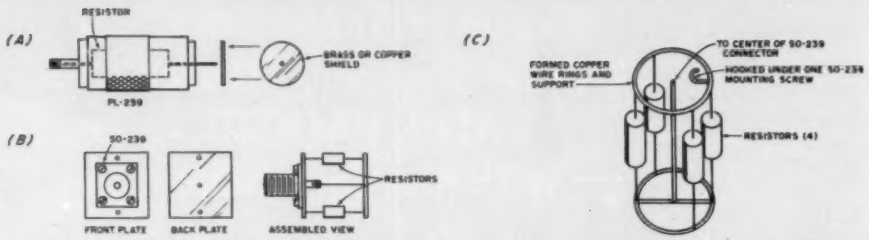

Fig. 1. At (c), the S-239 connector is mounted in the can lid. Make sure that the bottom ring does not make contact with the can.

In the interest of accuracy, it's worth the extra money to invest in 5% resistors for the above circuits. This will give a tolerance of ±2.5 Ohms for a 50 Ohm dummy load, which results in a mismatch of only 1.05:1. ■

Francis J. Piraino WA3KKM
Box 86
Pocono Summit PA 18346

Failsafe Super Charger

-- multi-rate, too!

At my QTH, many systems operate from a 12 volt dc automobile battery. The old saying "close the barn door after the horse runs away" applies to me. My QTH was burglarized; now I have a burglar alarm system. My system is simple yet quite adequate and it operates from 117 V ac and, in case of power failure, it switches to 12 V dc.

An automobile battery supplies the power, but keeping the battery at its peak was quite a problem and it was time-consuming. This is the reason for building the charger. It keeps the battery at full charge and never needs to be disconnected. In fact, since building this charger, I have added a power failure alarm. I have installed a 12 volt automobile FM stereo and tape player in my den. I operate my ham antenna switching system from this battery, and also my 2 meter FM transceiver when I remove it from the car. There were a few places I needed a light, and using a dome lamp assembly from an old auto worked perfectly.

This charger is rather simple and doesn't require any expensive parts. Any transformer with a voltage between 14-24 volts and rated at a few Amps can be used. Mine was from an old battery charger.

A two gang rotary switch and two 9 Ohm 30 Watt resistors are used to give me three charging rates when wired as shown in the schematic. Any charging combinations can be used provided the transformer and bridge rectifier can handle the current. The SCR listed is rated at 7 Amps with a heat sink.

Only one meter is used to read voltage or current. The meter shunt is in series with the positive lead to the battery and connecting the switch as shown will give you voltage or current. The meter face was reprinted to read 0-15 V dc and 0-4 Amps.

The pulse transformer was a small audio transformer which was rewound to give a 1:1 turns ratio at approximately 20 Ohms resistance. Since then I have seen them listed as SCR trigger transformers.

The unijunction is used as a relaxation oscillator, and the potentiometer controls the upper voltage limit for the battery. When this limit is reached, the oscillator stops oscillating, which in turn stops triggering the SCR. The battery must be connected for the circuit to operate. If the oscillator circuit fails to operate, reverse one of the pulse transformer windings. The SCR needs a positive spike at the gate to fire. ■

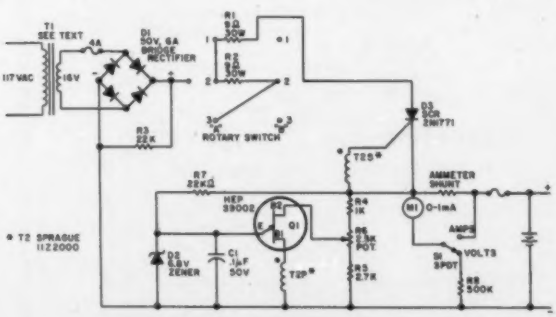

Fig. 1. Electronic battery charger.

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SPECIFICATIONS:

GENERAL:

Front Panel Size: 6½" × 2½"
Over-all Dimensions: 10½" deep × 6½" wide × 2½" high
Components: 13 Transistors, 10 Diodes, 6 FETS, 4 ICs
Frequency Range: 144 to 148 mHz
Number of Channels: 20 plus 2
Weight: Approximately 6 lbs.
Power Supply: 13.75v DC system, negative ground

RECEIVER:

Sensitivity:
12 db SINAD: .25 Microvolt
Selectivity: ±7.5 KHz, @ 6 db or less
Squelch Threshold: 0.1 Microvolt
Modulation Acceptance: More than 5 KHz
Adjacent Channel Rejection: More than 85 db (±30KHz)
Intermod response: More than 70 db
Image Responses: More than 70 db
Spurious Response: More than 70 db
Audio Output Power: 4 Watts at less than 15% distortion (5 Watts Max)
Frequency Stability: ±.001%
Circuit Type: Double conversion, Superheterodyne, Crystal Controlled. 8 Pole Crystal Filter
Intermediate Frequencies: 10.7 mHz 1st IF; 455 KHz 2nd IF
Current Drain: (Squelched) .2 Amps.
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TRANSMITTER:

Power Output: Hi: 30 Watts nom., 25 Watts min., @ 14v DC input
Lo: 1 Watt @ 14v DC input
Output Impedance: Matches standard 50 Ohm amateur antennas
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The Amazing 18" Antenna for 160m

-- get on topband simply

Many hams are interested in the low bands, but shy away from 160 meters because of the size of the antenna needed. Many of these same hams have the makings of an excellent antenna for this band, in the form of their tower and beam installation. With an easily added modification, they could be on "topband." The required additional space? About 18 inches!

A tower can be used as the grounded leg of a short unipole. (A unipole is half of a dipole, with the missing half replaced by a ground plane.) An added downlead makes the antenna a folded unipole (half of a folded dipole) and does some nice things for us – not the least of which is enabling us to more easily secure a good match to 50 or 75 Ohm feedline. Let's see why this happens.

At 2 MHz, a 50 foot tower is a short (.1 wavelength) antenna, and an antenna this short is highly reactive. If it were fed as a conventional vertical (as you might feed a short vertical mobile antenna on another band), it would require a large, lossy, and physically awkward inductance to cancel the reactance, and would be difficult to adjust properly. It would also display a very low radiation resistance, on the order of .5 Ohms, and be a very inefficient system.

Adding a downlead to form a folded unipole has the effect of raising the impedance by a factor of 4 (as does a folded dipole compared to a dipole), and therefore the radiation resistance is raised and the ground losses reduced by the same factor.

The downlead acts in the same manner as the gamma rod on a beam assembly, and changes the sign of the reactance. The required matching network is now a capacitive one, and is therefore a more easily adjusted device. If we take a page from the beam designers and add an additional shunt capacitor, we form an omegamatch, a network which has even more flexibility and will match a wide range of antenna/feedline impedances with ease.

The folded unipole is a broadbanded system, and will tolerate greater excursions from tune-up frequency before swr becomes excessive. Any 25 kHz segment may be covered, with no retuning necessary and swr remaining below 1.5/1.

My tower installation is composed of a Rohn foldover 50 foot, with a TH3 tribander and a couple of inverted vees for other bands, and a two meter beam. To add the downlead, I used a 30 inch piece of ½ inch aluminum tubing, clamped to the tower with stainless steel hose clamps. The downlead, a piece of #16 stranded, is attached to the tubing at a point 18 inches away from the tower, using a lug and a self-tapping screw. A short wire is attached to the tubing in the same manner, and the free end is secured to the tower under a structure bolt. This gives a solid, low resistance connection to the tower – without requiring any holes to be drilled in the structure. The downlead is secured to the base of the tower using another 30 inch tubing and clamp arrangement. An insulator and short lead to the omegamatch assembly complete the installation.

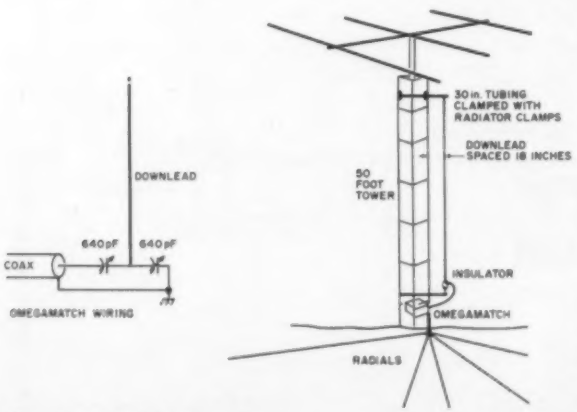

Fig. 1. The "hairpin" on top.

The omegamatch assembly is built using a couple of old dual 360 pF variables salvaged from an old radio. I would recommend wider spacing if possible, especially if higher power is authorized in your area, but running the legal (nighttime) power of 100 Watts input has not caused any arcover. Use heavy wire to make the various connections, as the current is high. I enclosed the omegamatch unit in a plastic Tupperware refrigerator box with a tight-fitting lid, and have had no problems due to moisture. There is rf present on the rotor of the series capacitor, so use adequate knobs.

Tune-up is accomplished using a grid dipper and antenna scope (or just feed low power to the system and adjust for best swr). A 1/1 match at tune-up frequency is easily obtained, and my installation enabled me to go 20 kHz above or below this frequency with less than 1.4/1 swr. Signal reports have compared favorably with other stations running comparable power with full-sized antennas.

This, like all verticals, requires a good ground system — not just a pipe a few feet in the ground. Radials, as long as possible (up to a quarter wave) and as many as practical, will assure a good system. They may either be laid on top of the ground with spikes to secure them, or buried an inch or so in the ground. I used an electric edger, and installed 25 radials in a short time. All wires should be soldered to a common ground bus, and this is attached to the tower with a large lug. Shield from a piece of scrap coax makes a good source of copper bus strap.

I hope this approach to the antenna problem will encourage others to try topband. It's a challenge, and fun. See you on the low end? ■

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Central SC 29630

A Great Way to Lay Out PC Boards

- - new use for shirt cardboards

Most projects hams try to build start with a schematic, and most circuit board kits tell you to draw the layout on the board and etch. The trouble is getting from one step to the other.

The method I use requires the simplest of tools and provides a template layout of the foil side of the board, a template for drilling the board, and a component layout.

The materials required are as follows: a hat pin, medium weight cardboard, a fine point pen, scissors, and some components (resistors, capacitors, etc.).

First cut the cardboard to the size of the required PC board, and mark all mounting holes with the pen. Next, bend the component leads to the proper length for use on a board. Place the lead ends of the component on cardboard and mark by pushing the pin through the cardboard, as shown in Fig. 1.

Next, using the pen, draw a line between the pin marks and indicate the component number or value as shown in Fig. 2. This will work as your component placement guide during assembly.

As you locate more parts on the cardboard, turn it over and draw in foil areas as shown in Fig. 3. This will serve as your layout for the project. Also, when the cardboard is placed over the circuit board, the pin holes can be used to lay out the location of holes in the board.

By doing your design this way you can get the best layout, and if it flops, all you lose is a piece of cardboard. ■

Fig. 1.

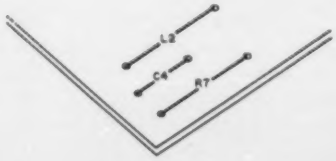

Fig. 2.

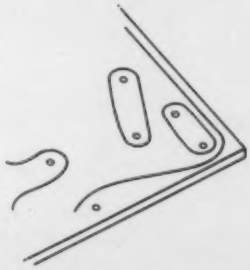

Fig. 3.

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102 Columbus Ave.
Greenfield MA 01301

Replacing the Knife Switch

-- simple TR system for the Novice

How many of us start our first ham station with manual transmit-receive switching? You know, "real" manual switching. First the other guy turns it over to you, then you throw the receiver into standby, then you throw the transmitter out of standby, and finally you frantically flip that little knife switch that does all the antenna changeover work. Maybe you've even forgotten all about it by now, but chances are that many of the Novices who are reading this are pretty familiar with how it feels to wonder if the other fellow gave up on you during the intermission. It's not an impossible situation to remedy, though. For about two thirds the cost of the popular Dow Key "60" coaxial relay, you can build a 1000 W capacity transceive switch that gives you convenient one switch operation.

The heart of this little gadget is a Kurman 115 V rf power relay, available from Lafayette Radio Electronics. This may be expensive, but compared to virtually any similar rf relay, the cost is a really solid investment. It has quite impressive specs.

The relay coil itself draws about a Watt at 115 V, but if you prefer odd coil voltages, models are available with 6, 12, and 110 V dc coils. The DPDT, self-wiping contacts are capable of handling 1.5 kW at frequencies up to 450 MHz. Standard G-7 insulating bridges provide excellent rf isolation between contacts. The relay can be easily mounted on one side of your enclosure by using the four tapped #6-32 mounting holes provided.

Construction

A four pole, three position telephone lever switch is used for the front panel transceive switching. The middle position provides a standby condition for both transmitter and receiver. Two of the DPDT contacts are used to switch the transmitter and receiver standby circuits, while the third energizes the relay. On my model, the fourth contact was used to short the receiver antenna terminals during transmit, thus providing extra protection from front end burnout.

Three SO-239 female coax connectors were mounted on the rear panel to provide standard interconnection to any rig. The power cord is also mounted on the back of the Radio Shack 5-1/4" x 3" x 5-7/8" cabinet, being passed through a grommet for safety's sake. Additionally, a four pin socket is mounted below the coax connectors for hookup to the receiver and transmitter standby circuits. Since transmitter standby is often just a switching of the primary of the plate transformer, the socket pins must be capable of handling 2 A or so. An optional power switch can be installed, as indicated on the schematic, but it's not really necessary because the relay will be turned off anyway when the lever switch is in the center position.

For most applications, the .001 uF bypass capacitors will adequately prevent rf from riding out on the incoming power leads. However, leads should be kept short on the capacitors bypassing the relay coil since such coils tend to pick up a lot of rf at high frequencies and subsequently put it right into the power line. Also, if the transceive switch is intended to be operated into a constant impedance, then coax is suggested for all rf carrying leads within the box.

This switching system allows considerable versatility at nearly any power level and with virtually any equipment. I experienced only one difficulty. It may be necessary to weight down the entire assembly to prevent it from moving all over the place when the lever is thrown.

Otherwise, you should have a reliable switch that will serve your needs for many years to come, no matter how much your other equipment changes. ■

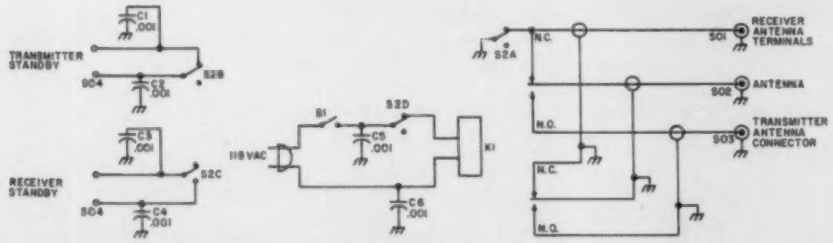

Fig. 1. Optional switch S1 (SPDT toggle) is shown in the off position, while S2 (4PDT telephone lever switch) is shown in the transmit position. C1-6: .001 uF, 1 kV, disc ceramic. K1: DPDT rf power relay (Lafayette #30E22217). S01-3: SO-239 female coax connectors. SO4: 4 pin socket, all pins well isolated from chassis, capable of 2 A. Enclosure: Radio Shack 5-1/4" x 3" x 5-7/8" metal cabinet.

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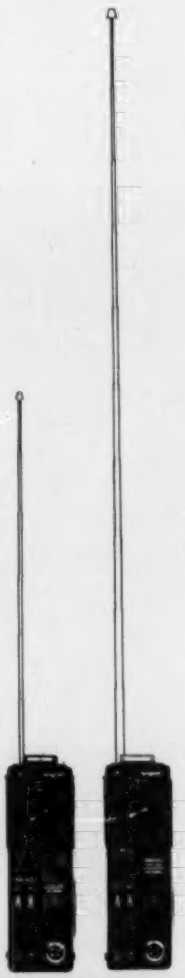
Take hold of Single Side Band. Take hold of some excitement. Take two.



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$25 for a Connector? You're Crazy!

- - do-it-yourself 7/8" coax connectors

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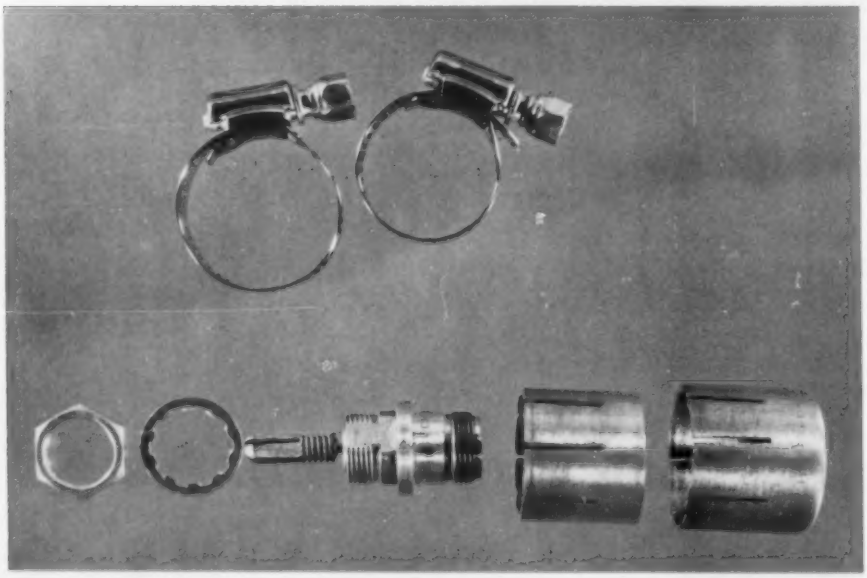
Measurement of output power at the transmitter, in comparison to output power at the antenna end of a transmission line, will show how much power is lost in the transmission line. You may be shocked at how high this loss really is, especially if you are using conventional coax for your transmission line. Power lost is power wasted and remember that transmission line loss affects your received signals as well. Loss in received signal strength is usually of more concern than loss affecting transmitted signals.

Loss in a transmission line becomes greater as the frequency is increased. Therefore, loss is of considerable importance for the 420 MHz band which is becoming quite popular due to satellite, ATV, EME and other types of communications. "Put your antenna up as high as possible, but keep your transmission line as short as possible" may be good advice, but it is not an easy thing to do. The longer your transmission line, the greater the loss.

One way to reduce transmission line loss is to use 7/8" helical wound cable. This type of cable is available and often can be found at hamfests, usually at very reasonable prices. Sometimes it is "used" cable, still in excellent condition after being retired from a commercial installation. The price of helical cable may be considerably less than conventional coax.

The 7/8" helical wound

Photos courtesy of Lynn Finch WNØNYC



Component parts of connector unit prepared for assembling. Connector pin is soldered in place.

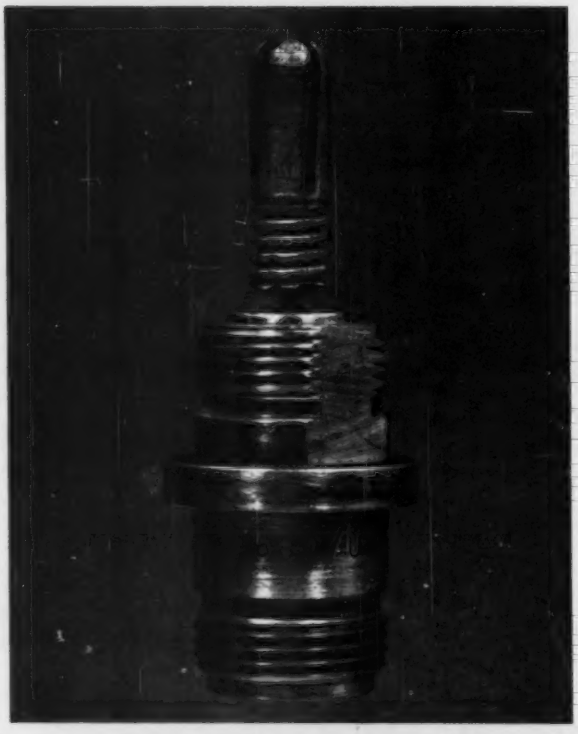
cable is semi-rigid and measures about 1" in diameter, including the protective outer jacket. It has a hollow 1/4" diameter copper center conductor and 7/8" helical wound copper outer conductor with teflon dielectric between the two. This high quality, 52 Ohm impedance cable has much lower loss than conventional coax and should provide many years of excellent service in an amateur installation.

So, what about connectors? They are necessary when using 7/8" helical wound cable, but many amateurs have been discouraged from buying or using it when they learn the connectors would cost several times more than the cable itself. These connectors are difficult to obtain, and they are very expensive. Also, they are not normally available on the surplus market. So how can you use quality cable without spending a small fortune on accessories? Why not make your own connectors? This is how I solved the problem of using 7/8" helical wound cable.

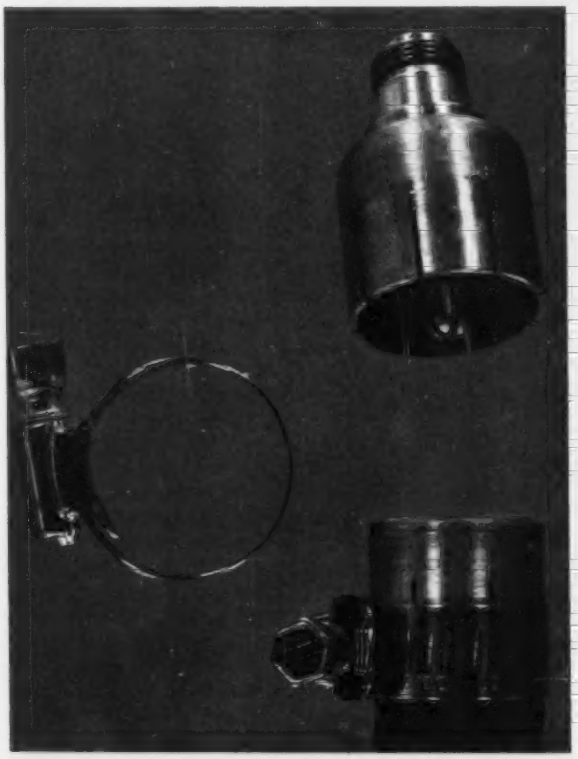
Common tools are used, and the few parts required should be easily obtained at low cost. The parts list for one cable connector assembly consists of one UG-680/U "N" type connector, one 1" length of standard 1" copper pipe, one standard 1" copper pipe cap, two size 12 stainless steel hose clamps, and one 3/4" length of 1/4" diameter brass rod (copper rod should work equally well).

Using a hacksaw, make eight 5/8" long slots in one end of the 1" length of pipe. Saw similar slots in the open end of the pipe cap. With a chassis punch make a 5/8" hole in the center of the closed end of the pipe cap.

Unsolder and remove the wire terminal lug from the center pin of the connector, saw two 1/2" long right angle slots in one end of the brass



Close-up of "N" type connector with fabricated center pin. The threaded portion of the pin is immaterial.



Expanded end of connector pin shown provides snug fit into center conductor of cable.

The completely assembled product ready for weatherproofing and final installation.

rod, and round the end off slightly with a file. The four pieces from sawing the slots should be spread enough to provide a good snug fit when inserted into the 1/4" center conductor of the cable. Center and drill a small hole in the other end of the rod, to slip over the end pin of the connector. Using a small torch, solder the connector pin in place.

Remove a 1" length of the protective outer jacket from the end of the cable. Then slip the slotted end of the pipe over the outer conductor of the cable, and secure with a hose clamp at the slotted end. Be sure that the other end of the pipe is flush with the end of the cable, then tighten the hose clamp.

Mount the connector in the pipe cap with lock washer and nut and tighten securely. Assemble by sliding the expanded end of the connector pin into the center conductor of the cable. The slotted end of the pipe cap should slide 1/2" over the pipe previously secured in place. Secure the pipe cap in place by placing a second hose clamp at the slotted end and tightening the clamp.

For long term stability, it is desirable that all connector parts be silver plated before assembly. This is not absolutely necessary, however, since the cable conductors themselves are bare copper. Be sure to thoroughly weatherproof the entire connector assembly. I use a silicone rubber sealer and it works fine. "N" connectors are supposedly "weatherproof," but I use sealer to be sure.

If you remembered that there are two ends on your cable, then you probably doubled the quantity of each item required. If so, you are ready to make a connector assembly for the other end of your cable. Install it, and start enjoying the advantages of using a low loss transmission line without the headache of special (and expensive) connectors. I think you will agree the results are well worth the effort. ■

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Now You Can Synthesize

-- the VHF Engineering approach to 2m happiness

After nearly two years of active crystal buying, otherwise known as 2 meter operating, I finally broke down and started shopping for a synthesizer. Being known as one so tight that I squeak when I walk, cost effectiveness was a prime requirement. My attention was captured by the VHF Engineering Synthesizer II ad in the Dayton Hamvention program and then by their exhibit, when they introduced the unit, in April. This unit also met requirement number two — I could assemble it myself.

So I ordered one. I was told it would be about six weeks for delivery. It came July 12th (Monday), which comes out to eleven weeks, not too far off my own guess of ten weeks, as this was a new product. In my later conversations with VHF, they said they did not get satisfactory boards until the first of July. So they were very prompt in sending out the kits once they got going.

The wait for good boards was worth it. I didn't start on assembly until Wednesday night about nine pm, and quit at eleven-thirty, and did the same on Thursday and Friday, then played golf Saturday. Sunday morning I worked DX on the low bands, and still put the synthesizer on the air about four pm Sunday. With no snags.

Well, almost none. I made one error at eleven pm on Saturday that was my own fault — I wired the thumbwheel switch multi-wire ribbon conductor *THROUGH* the switch mounting hole instead of *OVER* the front panel, so I had fourteen wires to remove and redo. Judging from the manual (which is very well done), the author was left-handed. The whole thing was much easier in reversed sequence.

Also, I broke two tuning slugs working on the VCO coil, as the coil form tightens down on the slug due to the pressure of the grommet against the plastic form. This is not a serious problem, just an aggravation. But be sure you have clean-running, lubricated threads when you do this part of the assembly, and put the slug in long after the can is bead-soldered to the board.

Since this was one of their first production units, I expected to find several board or instruction errors. There were none on the board (which is a good quality, double-sided board with all components on one side). No parts were missing or bad, and I only caught two instruction errors, one very minor. The major one is obvious — in the section on receiver output alignment, the chokes L-2 and L-3 are being adjusted, and in one line it says "realign L-1 and L-2" where it means L-2 and L-3, as L-1 is the VCO coil.

The minor error is omission of the holes for the LM309K and the transistor leads in the chassis drawing

on page 16. And there was one minor sheet metal problem with the alignment hole for the offset selector switch being too small. I just used an ice pick to "persuade" it open slightly.

The unit works well, with nothing but good reports on audio quality and frequency stability. Construction was clean and simple, everything worked. I did add an LED pilot light (LED and 330 Ohm resistor from the thumbwheel switch five volt common to ground) to let me know the unit is energized. There is one minor drawback. Since the Synthesizer II programs offsets up to 10 MHz in 100 kHz steps, I can't program the 146.115-146.70 pair used in Cincinnati. But with five other positions on my HW-202, I don't really feel too bad about that.

All in all, the $169.50 kit price was an excellent cost effective purchase, and is a real help to the construction ego by working the first time. ■

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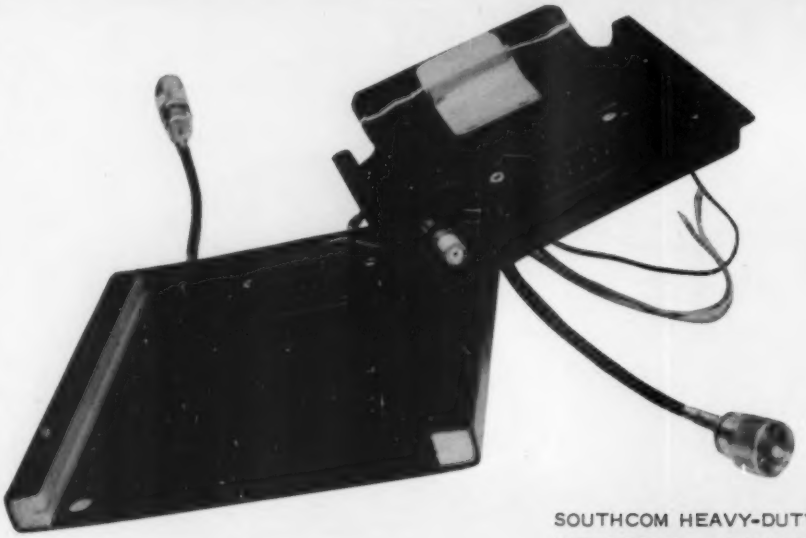

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IC Audio Frequency Meter

-- another use for the 555

The 555 timer integrated circuit can easily be made into an inexpensive linear frequency meter covering the audio spectrum. The 555 is used in a monostable multivibrator circuit. The monostable puts out a fixed time-width pulse, which is triggered by the unknown input frequency.

Referring to Fig. 1, transistors Q1 and Q2 are used as an input Schmitt trigger. The unknown frequency input is clipped between 9 volts and ground by these transistors. Positive feedback is used to insure the waveforms have fast, clean edges. The output of Q2 is a square pulse with the same frequency as the input signal. The output of Q2 is differentiated by C2 and R2 to provide a short pulse for the 555. A small signal diode is connected across the differentiator to insure that the 555 input never exceeds 9 volts. The 555 is connected in the standard monostable circuit. Since a Schmitt is used to trigger the monostable, square, sine and ramp type waveforms may be used at the input to the frequency meter. A nominal voltage of 1 volt rms is required to trigger the Schmitt circuit.

The range scale timing resistors R3, which determine the monostable pulsewidth, are small potentiometers mounted directly on the circuit board. These pots are used to calibrate each frequency scale.

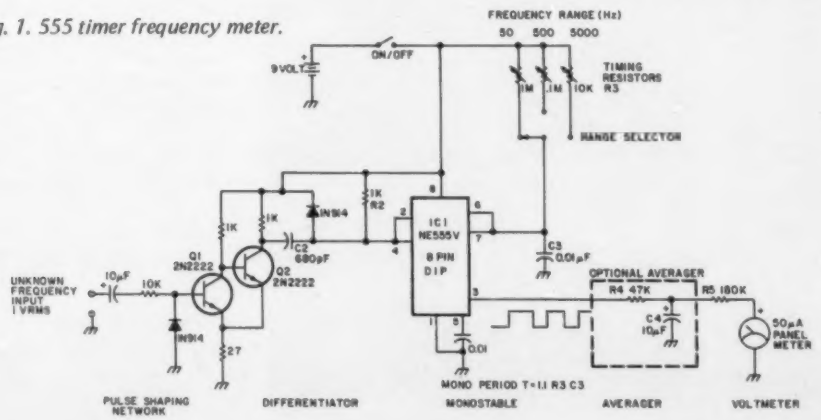
The output of the monostable is a fixed width pulse. Every time a zero crossing of the unknown frequency occurs, the monostable is triggered. Thus, as the frequency of the trigger pulse increases, the monostable output has a greater and greater duty cycle. The frequency limit on any one range is determined by the R3C3 time constant chosen. As the input frequency becomes too great, the monostable output will never return to zero, because of constant re-triggering, and a constant 9 volts will appear at the output.

The monostable output is a pulse with a duty cycle dependent upon the input frequency. Thus, by integrating or averaging the output waveform, a dc voltage is developed. This voltage is directly related to frequency. Resistor and capacitor R4C4 is used as a pulse averager, important on the lower range setting. As the input frequency increases, the panel meter itself can act as a waveform averager. Input frequencies greater than 50 Hz will be averaged by the meter fairly well; however, at lower frequencies the meter will respond to each cycle of the unknown frequency input. The meter is used as a high impedance voltmeter. A 1 mA meter could be substituted with a change of resistor R5. For a 1 mA meter, R5 should be about 9.1k and R4C4 should be changed appropriately. R4 should be a factor of ten less than R5, and the same R4C4 time constant should be kept. This would make C4 a very large value, so R4C4 could be left out if the lower frequencies are of little interest (less than 50 Hz).

The range scales are set up in decades. To calibrate each scale, a standard input frequency is connected to the input. About 1 volt rms is needed to trigger the first stage. The monostable output pulse period must be less than the maximum input frequency to be measured on each scale. With the maximum input frequency applied, each range potentiometer should be adjusted until the value of the input frequency corresponds to the full scale meter reading. The duty cycle of the monostable should be roughly 90% at the maximum frequency input for each scale. This will give the maximum dynamic range on each scale setting. If, for a 90% duty cycle, the meter will not read full scale, meter resistor R5 should be lowered accordingly. Each scale setting should be calibrated by adjusting the respective R3 potentiometer.

During operation, when the scale reads off scale on any range, the scale should be changed to the next higher setting. Once calibrated, this frequency meter should read within 5% of full scale. The useful frequency range of the meter is from tens of Hertz to well over 50 kHz. Although decade ranges are shown, the ranges between the decades can easily be added to give as many frequency ranges as deemed necessary. ■

Fig. 1. 555 timer frequency meter.



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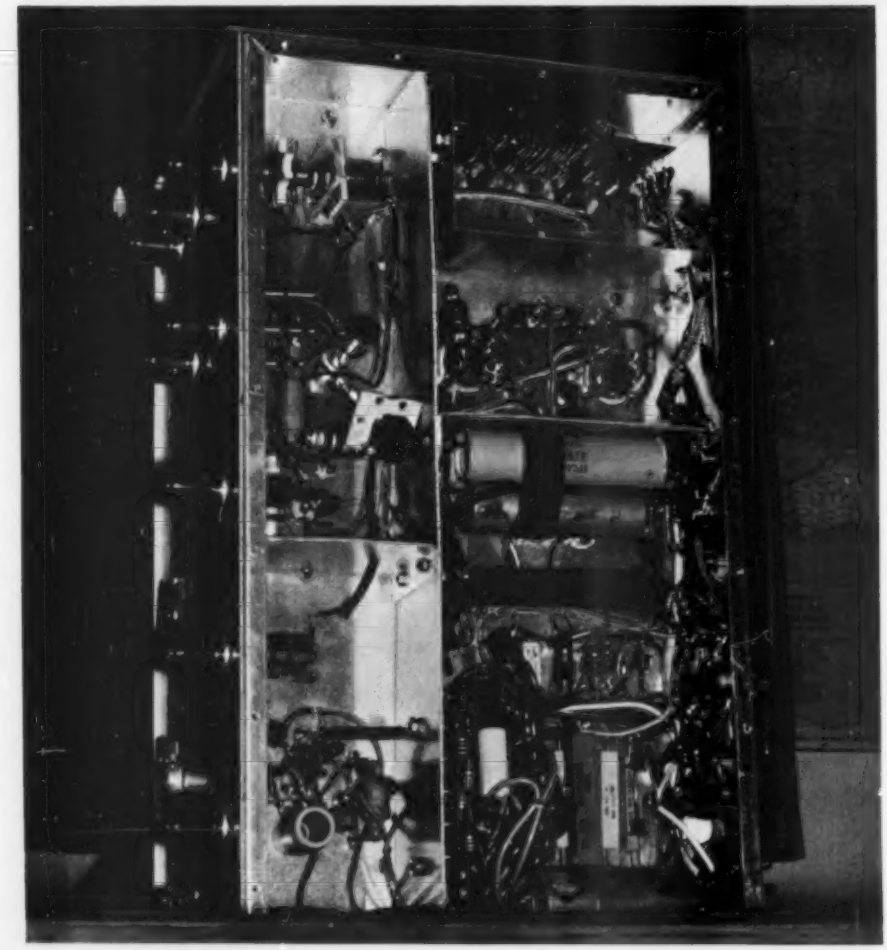
Hutchinson's Remedy

-- the chirpless CW machine

If you have ever built your own rig with vfo control, you will know that it is nearly impossible to key the vfo and maintain a chirpfree note. You can often get away with keying the oscillator when operating on 3.5 MHz or 7 MHz, but at 14, 21 or 28 MHz small changes in the vfo frequency caused by keying become magnified many times. The resulting "note," if not embarrassing, is not easy to copy.

There have been two common remedies that I know of to achieve chirpfree operation. The first is differential keying, described in the *Radio Amateur's Handbook*. The idea here is to build a circuit which turns the vfo and the final amplifier on and off at different times. When the key is pressed, the vfo turns on immediately, and after a delay of, say, 3 ms, the final amplifier turns on. In this 3 ms interval most of the chirp will have occurred and will not be amplified. Similarly, when the key is released, the final amplifier turns off immediately, but the vfo turns off about 3 ms later. Again, any chirp at the end of the character is not amplified.



Well, this all sounds good and it does work to some extent, but my experience is that with my vfo, which is the series-tuned Colpitts one described in the chapter on oscillators in the *Handbook*, the chirp at 28 MHz is so bad that it extends over the length of an entire dash or dot when I'm sending at 20 wpm. No amount of differential keying is going to cure that!

The second standard remedy works better, but it costs more, too. This is to have your vfo run all the time and mix its output with the output of a crystal oscillator. The beat frequency of 3.5 MHz, or whatever, is then amplified. Here you key the crystal oscillator and the final amplifier together. The crystal oscillator is so stable that it can be keyed with very little chirp. This method works well, I should think; I've never tried it but often read about it. It's too expensive, and if you're inexperienced you might have trouble getting the mixer circuitry properly tuned.

Hutchinson's Remedy

My circuit is moderately simple, requires no adjustments, is adaptable to any

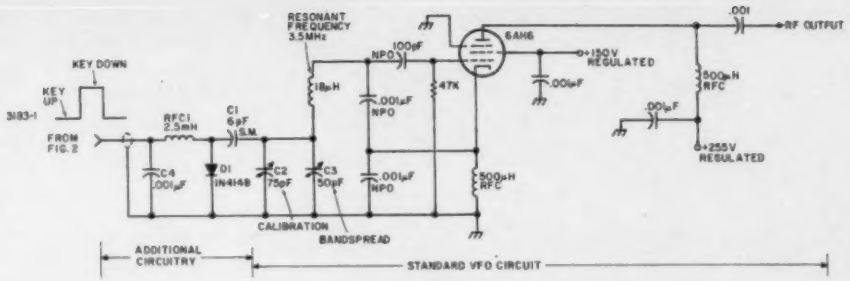


Fig. 1.

vfo, and gives unsurpassed chirpfree break-in operation. The principle here is that of allowing the vfo to run continuously at a frequency slightly higher than the frequency on which you wish to operate. When you press the key, a small capacitor is electronically switched in parallel with the main tuning capacitor in the vfo to lower its frequency to the operating frequency. When the key is released, the vfo frequency snaps back up to where it was before. This allows you to listen on the operating frequency between dots and dashes without the vfo interfering. Since the vfo runs all the time, there can be no chirp. I have incorporated a differential keying circuit which delays the turn-on of the final amplifier at the "make" of each character and delays the upward switching of the vfo frequency at the "break" of each character. This is needed so that you do not amplify and transmit those frequencies being generated while the vfo frequency is in transition from high to low or from low to high.

You must make sure, of course, that there is sufficient isolation between your vfo and your final amplifier so that the vfo frequency is not "pulled" by the final amplifier. The test for this is to allow your vfo to run continuously and key only the final amplifier while listening for any chirp that would indicate pulling. The circuit to be described cannot cure chirp caused by pulling.

Circuit Details

Fig. 1 shows the series-tuned Colpitts oscillator operating at 3.5 MHz. D1 becomes forward-biased when the key is pressed, effectively placing C1 in parallel with C2 and lowering the frequency of the vfo by approximately 50 kHz. C1 is purposely very small so that if you are installing this in a vfo whose dial is already calibrated, you can maintain this calibration by reducing C2 by 6 pF. Also, such a small capacitor is not likely to upset the Q or temperature stability of your resonant circuit. D1, RFC1 and C4 are placed as close as possible to C1 and within the same enclosure as C2.

Referring next to Fig. 2, a Schmitt trigger conditions the contacts of the key so that dirty contacts still give good operation. U2 is a monostable multivibrator that delivers a pulse about 3 ms wide when the key is pressed. The negative going pulse from pin 1 goes to flip flop U3A which toggles on the *leading* negative going edge of the waveform. At the same time pin 6 of U2 delivers a positive going pulse to U3B, but since the SN7473 flip flop triggers only on negative going transitions, U3B toggles later, on the *trailing* edge of the 3 ms pulse. Assuming U3 was cleared beforehand ($Q3A = \overline{Q3B} = 0$), this means that the output of U4B goes to zero the instant the key is pressed, while the output of U4C goes to one 3 ms later. The output of U4B is inverted by U1D and used to control the frequency of the vfo. By closing S1 you can spot your operating frequency. The output of U4C is inverted by U4D. When pin 1 of U4D goes to 0, Q2 becomes forward-biased and turns on the final amplifier.

When $\overline{Q3B}$ of U3B goes to 0 at the end of the 3 ms pulse, pin 12 of U4A and hence pins 3 and 5 of U2 go to 0 also. This sets up U2 to send out a second 3 ms pulse at the moment the key is released. Again U3A toggles before U3B and this time U4C switches immediately while U4B switches 3 ms later. So the final amplifier turns off the instant the key is released and 3 ms later the frequency of the vfo switches upward by 50 kHz. The circuit is now back in its initial state ready for the key to be depressed again.

Q2 is set up for grid blocked keying and with the values of R1 and R2 shown it will operate properly with grid currents up to at least 6 mA, which is what the pair of 6146Bs in my final requires. At higher currents the grid current flowing through R1 becomes comparable to the current set up in R1 and R2 by the 5 V source. This disturbs the biasing of Q2 and, once turned on, it may not shut off. To operate with higher grid currents you may have to reduce R1 and R2, keeping their ratio still about 1:1. This, of course, would increase the base current to

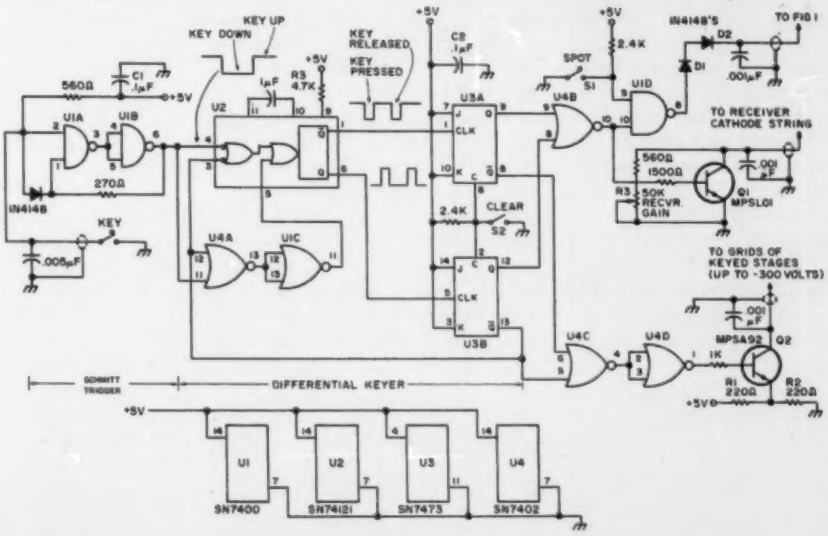


Fig. 2.

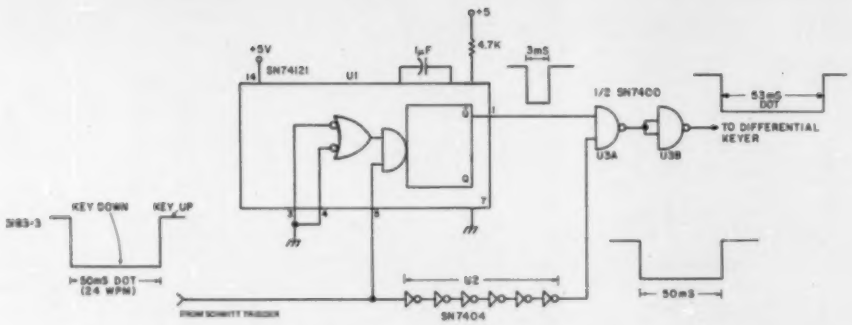


Fig. 3. Optional character stretcher.

Q2. You'll find the MPSA92 Motorola transistor (Q2) very inexpensive (about $1) and it will handle the highest grid blocking voltages in my experience.

A bonus feature of this differential keyer circuit is that the output of U4B can be used to key your receiver for full break-in operation. A low output from U4B turns down the gain of the receiver, while a high output from U4B restores the gain to normal listening level. The beauty of it is that the gain goes down *before* the final amplifier turns on and the gain is restored only *after* the final amplifier turns off. The result is smooth operation without clicking or popping sounds from your receiver.

In my particular receiver, a Hallicrafters SX-96, the gain is controlled by a potentiometer connected between the cathodes of the various stages and ground. Provision is made through a power plug at the back of the receiver for connecting an external resistor or switch in series with this potentiometer to alter the gain. Q1 in Fig. 2 acts as a switch in this regard. When Q1 conducts, the gain is high; when Q1 shuts off, the gain is low and depends on the setting of R3, an external control, which you adjust for a comfortable level to monitor your transmissions. Although your receiver may differ from mine in these details, there will be some way to key it and you may have to alter this part of the circuit to meet your needs.

You may be wondering about the function of diodes D1 and D2 in Fig. 2. They insure that when the output of U1D is low there will be no current through D1 of Fig. 1. Even a slight current in D1 of Fig. 1 effectively places C1 across C2 and lowers the frequency of the vfo.

In Fig. 2, S1 and S2 are shown as separate switches, both normally open. In practice you may wish to use an SPDT switch with center off. Always remember to close S2 momentarily when you first turn on your rig in order to clear the flip flops. Further clearing should not be necessary, providing your key does not have excessive contact bounce. Contact bounce up to 3 ms long is acceptable, but any bounce after that will retrigger U2 prematurely and give unpredictable operation. Even the worst key shouldn't bounce that long! Of course, you can always lengthen the 3 ms pulse by increasing R3 at pin 9 of U2, but you can't do this forever because each dot and dash gets shortened by an amount equal to this pulsewidth. At 24 wpm, a dot is about 50 ms long, and if you chop off, say, 10 ms from this, you start to notice.

For the CW perfectionist who objects to losing 3 ms or so of each dot and dash (that could add up to a few minutes after many QSOs!), there is a solution. The circuit in Fig. 3 can be connected between the Schmitt trigger and the differential keyer to artificially lengthen each character by 3 ms so that the transmitted characters end up precisely the right length! In Fig. 3, a 3 ms pulse is generated by U1 upon each release of the key; NAND gate U3A adds this on to the end of the character just sent. U2 serves as a delay line, insuring that the falling edge of the 3 ms pulse reaches U3A before the rising edge of the waveform from the Schmitt trigger does. The circuit works, but as I said, it's only for the very fussy operator.

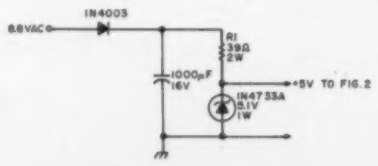


Fig. 4. Power supply.

Construction

I constructed the circuit on a 7.2 cm x 12 cm piece of veroboard, with the 2.54 mm hole spacing that is compatible with the IC pin spacing. Since the circuit will be used in the presence of rf fields, you must bypass each lead to the board with a .001 or .005 uF ceramic capacitor. If rf fields are very strong, you are advised to use properly bypassed shielded wires leading to and from the circuit board. Failure to take precautions in preventing the influx of rf energy to the circuit will result in the flip flops triggering unpredictably, and you will be constantly pressing the clear button S2 to get things working again. Under some circumstances, I've found it necessary to place a .005 uF ceramic capacitor directly across the terminals of the key. Also the 5 V line is bypassed with low voltage ceramics C1 and C2 in two separate places to reduce switching transients.

The ground connections in Fig. 1 and Fig. 2 must be connected to your receiver ground, and transmitter ground also, so that Q1 and Q2 will key them properly.

The power supply shown in Fig. 4 is suitable for running the circuits in Fig. 1, but you will likely have to lower the value of R1 if you also want to operate those in Fig. 3. Although the power supply could have been designed to work from 6.3 V ac, I often encounter low line voltage situations and decided to borrow another 2.5 V from a spare filament winding in the rig just to be on the safe side. That's how you get that odd value of 8.8 V shown. The measured current requirement of Fig. 2 was 95 mA with key down (maximum current condition).

In Fig. 1, make sure you keep the leads of C1 and D1 short so that your vfo remains mechanically stable. I used silvered mica for C1 and it seemed to be adequate. If your vfo is of a different type, there should still be no problem as long as one side of your tuning capacitor is grounded. Just connect C1 to the ungrounded side as shown.

Conclusion

I have had this circuit in use for some time now and am pleased to report that on all bands (80m-10m) the many amateurs I have worked report that there is no detectable chirp on my note. ■

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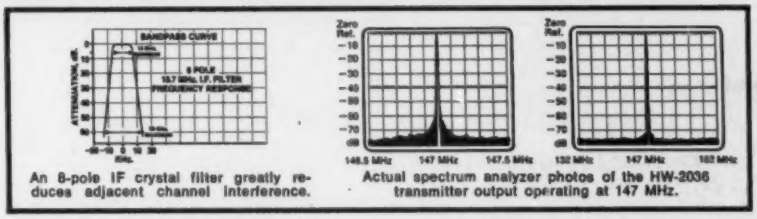
And the signal is solid! The HW-2036 puts out a minimum 10 watts at 25° C and 13.8 VDC. And it operates into an infinite VSWR without failure. The transmitter output is extremely clean (see spectrum analyzer photos above). True FM circuitry means you transmit and receive with excellent audio quality too.

The receiver is hot! Sensitivity is an outstanding 0.5 μV for 12 dB SINAD. An 8-pole IF crystal filter provides an ideally shaped bandpass for excellent adjacent channel rejection and its superb selectivity characteristics make it the one to have for crowded signal areas.



An 8-pole IF crystal filter greatly reduces adjacent channel interference.

Actual spectrum analyzer photos of the HW-2036 transmitter output operating at 147 MHz.

Complete operating versatility! A built-in continuous tone encoder — with three tones selectable on the front panel accesses most repeaters. Built-in simplex, + and − 600 kHz offsets, and an Aux. position that lets you add a crystal for any other frequency gives you all the offset capability you'll ever need. And, if you order the HW-2036 with the Heathkit Micoder combination microphone/auto patch encoder, you'll be able to make phone calls through repeaters equipped with auto patch input!

The HW-2036 operates from its built-in 12 VDC power supply, or you can use the optional HWA-2036-3 AC power supply, and operate it from a fixed station.

The HW-2036 is our best 2-meter transceiver. Check it out for yourself and you'll see it's the one to have for years of reliable 2-meter communications. Read more about the HW-2036 and all the other superb Amateur radio products in new Heathkit catalog. Mail card or send coupon today!

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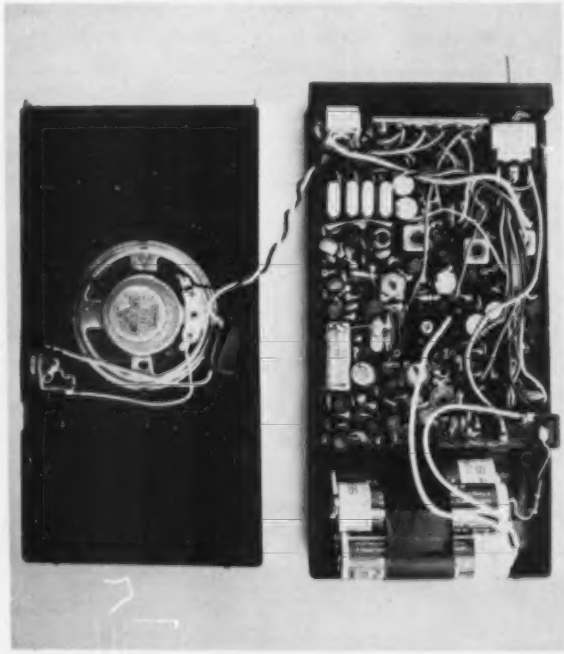
The Mod Squad Does the Pocket Scanner

-- Radio Shack PRO-4 updated

Last year, my wife gave me a Pocket-Scan for my birthday. This little receiver has proven to be a great monitor receiver on 2 meters. The only real drawback was that it required two 9 volt batteries, wired in parallel, to power it.



After a while, it became rather expensive replacing these batteries and I have been unable to find a nicad replacement.

In November, 1974, Radio Shack came out with their PRO-6 model Pocket-Scan which is powered by four "AA" batteries. I managed to obtain a copy of the schematic and compared it with the schematic of the PRO-4. I found the circuits to be very similar, so I proceeded to compare resistance values.

Table 1 is a list of the resistors and capacitors I changed and their nomenclature as indicated on the *PRO-4* schematic. If possible, use ¼ Watt resistors due to space limitations on the PC board.

I found that leaving the series resistors for the LEDs (R51-54) alone had no appreciable effect on their operation. If anything, they reduced the current drain on the nicads.

Speaking of current drain, my Pocket-Scan now draws 21 mA while scanning and approximately 30 mA while receiving a signal with the volume set at a comfortable level. With this in mind, the batteries should last about 15 to 21 hours on one charge. In actual practice, the receiver operates for about 16 hours on one charge, or about one hour of operation per one hour of charge time. Plenty of time for the average hamfest or just day-to-day use.

Getting back to the parts replacement, there were two problems. One was the audio section. When I first "completed" the conversion, the best I could get was distorted, hard to understand audio. Also, the amplifier tended to oscillate. I discovered that I had too much bias on the base of Q19; thus the insertion of the 100 Ohm resistor in series with R47. The voltage on the base should be about 2.6 volts. Also, the replacement of C61 is critical or the amplifier will oscillate. Use as small a 470 pF as possible. Finally, use the capacitor from C39 to replace C52. This also adds to the amplifier's stability.

As referred to in the parts list, R44 is removed. Take a razor blade and cut the circuit foil between C47 and R44. Next take a 10k (preferably a ¼ Watt unit) resistor and bridge this gap (note the photo). Replace R44 with an 82k resistor.

The second problem was the 1st mixer transistor (Q2). The receiver worked well for about 2 weeks, then all of a sudden the transistor blew. I believe this to be the result of too much V_{be}. It should be about .6 volts. The replacement of R4 should remedy the problem.

Anyway, I also replaced Q2 with an RS 2015 from Radio Shack. This is the replacement for the 2SC784(0) as indicated on the schematic of the *PRO-6*. The RS 2015 is really a 2N4996. This tran-

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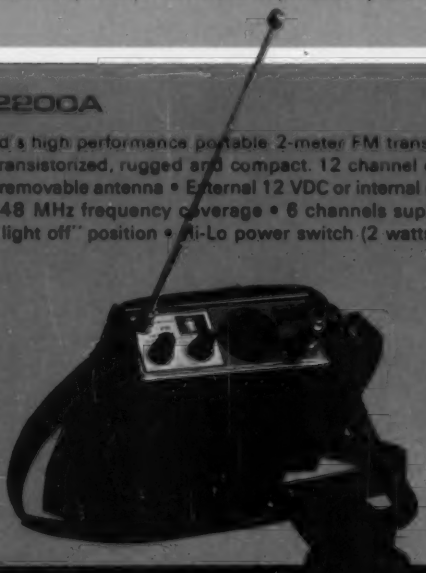

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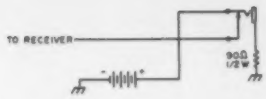

Fig. 1.

sistor greatly improved the sensitivity. A word of caution, though: If Q2 does blow, turn off the receiver immediately; otherwise, T4 will blow, also. I was able to repair mine, but you may not be so lucky.

As shown in the photos, the nicads are soldered together. There is not enough room for any kind of battery holder. Since the batteries cannot be removed, I installed a 90 Ohm ½ Watt series resistor for charging. I am using the 9 V dc supply I received with the Pocket-Scan as the charger. Since the radio operates so long on one charge, I did not provide for ac operation. Fig. 1 is the schematic of how I wired the built-in power connector.

Note the other miniature connector in the photo. I used this for another earphone jack because the one in the top panel is a sub-miniature.

Now, you ask, when do I charge the batteries? I have found that when the audio quality deteriorates and the volume goes down, it is time to recharge.

The Pocket-Scan is now converted to nicad operation (5 V); we now need to tune up the receiver to operate on 2 meters.

The front end (consisting of T1, T2, T3 and T5) is tuned for minimum noise on a signal on 146.94. Use a pair of headphones for the best results. I found that the best way is to turn the slugs down into the transformer and then bring them out for minimum noise. When you reach the minimum noise point, STOP. Going farther will do no good.

There are three more transformers. T4 is the 10.7 i-f and should not require retuning. T6 and T7 are the discriminator coils. Note that there are two test points. Use TP-2 and an 11 megohm VOM/VTVM to peak T6 and dip (that is to 0 volts) T7. Of course, in order to peak and dip these coils, you must be receiving a signal.

I have found that TR-22C crystals work just fine or you may wish to have crystals made for the PRO-4. With my PRO-4 tuned up on 146.94 and some playing with T7, the discriminator voltage is + or - .1 volts with my crystals and they include: 146.67, 146.76, 146.88 and 146.94.

This completes the tune-up on the PRO-4. I have found it to be quite sensitive on 2 meters and I can still hear KEC 76 on 162.55 for local weather. Of course the sensitivity is somewhat degraded but acceptable for the weather station.

Since I do not have any test equipment other than my VOM, I can only judge by ear, but the Pocket-Scan seems to exhibit the same sensitivity as my TR-22C as both can hear WRØAEK (16/76) in Colorado Springs (70 miles) with about the same amount of noise. ■

CHANGE . . .	FROM . . .	TO . . .
R2/C5	100/.001	Remove & short.
R3	1k	100
R4	470k	1 meg, see text.
R17	100	Remove & short.
R19, 21, 22, 25, 27	470k	330k
R31	470k	100k
C38	.01	.005
C39	.01	Remove.
R42	4.7k	2.2k
R43	100	Remove & short.
R44	62k	Remove & see text.
R47	68	Add 100 Ohms in series, see text.
R48, 49	3.3	Add a 10 Ohm resistor in parallel with each 3.3 Ohm resistor. See photo.
R50	3.3k	Remove & short.
C52	.0015	.01
R56	1k	47
R57	10k	3.3k
R58	22k	Remove
R60	22k	10k
R61	10k	3.3k
C61	330 pF	470 pF (see text)
R62, 63	22k	10k
R66	33k	10k

Table. 1.

Larry Macionski WA2AJQ
707 Willis Avenue
Syracuse NY 13204

TR-22 Mod Squad

- - king of the modifieds ?

In the February, 1973, *73 Magazine*, Jerry Copeland W8FJA wrote an article about increasing the power output of a TR-22. Since then, Peter Stark K2OAW has written an article on revising previously printed articles so that you can write your own article, have your name in print and become a famous author (May, 1975). Therefore, credit goes to the above.

In this article, I use the terms TR-22 and TR-22C. TR-22C specifically refers to a TR-22C. These modifications can be made to both.

Several months ago I made a trip to VHF Engineering to purchase a PA-2501 amplifier. My concern was whether the PA-2501 could handle the power of my Standard SRC-146A, which I alternate as a mobile rig with the TR-22C. Bob Brown gave me a Motorola MRF-237 transistor with the spec sheets and said that perhaps I could use this transistor in my TR-22C. Hospitality at VHF Engineering makes it well worth the trip.

After returning home and spending three hours assembling the PA-2501, it was installed in the car and I went off to see if the MRF-237 would work in the TR-22C.

A phone call was made to William Frost, service manager of R. L. Drake. I found that he had had experience with W8FJA's modification, and that he had seen some failures of the TR-22's output transistor because of the fact that the unit was operated without a load. In one sentence, W8FJA's modification to the TR-22 was to change the driver transistor to a Motorola HEP-75, to increase the power to 2.7 Watts. Higher power output was thus achieved by driving the original transistor harder.

I might mention at this time that you should go out and dig up W8FJA's article, in the February, 1973, *73 Magazine* (page 91), and read it for more insight into what I am going to do. As you can see, he borrowed the idea from Jack Lemon WB6CTA. I knew there was a 6 looking for more power.

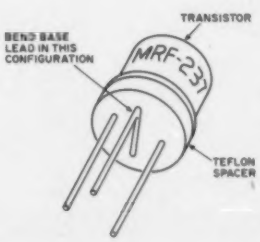

Fig. 1.

Now that you have returned from his article, go down to your local Motorola dealer and order an MRF-237. I paid $1.80 for one to modify a friend's TR-22C. Get out the manual, the TR-22 or TR-22C, a wattmeter or swr bridge, soldering pencil, solder sucker, needle nose, screwdrivers, and wire cutters.

Remove the TR-22 case. Remove the telescoping antenna and then remove the receiver board by unscrewing the four phillips screws and turning the board over and over and away from the aluminum chassis. This exposes the bottom side of the TR-22 transmitter board. My first modification was simply to locate and remove the power output transistor. It's the one with the big square heat sink. You can't miss it. Now comes the trick. The MRF-237 uses a grounded emitter (TO-39) and the lead configuration is reversed from the original transistor leads. Therefore, you must place a teflon transistor pad between the collector and emitter leads. Rebend it again to obtain the triangular lead pattern – only reversed from what it was. See Fig. 1. Be sure to use a teflon spacer. They are plentiful on surplus computer boards. Do not use a cardboard spacer. It will attract moisture and degrade performance. Remove the original output transistor and remove the heat sink by expanding it with a screwdriver. Install the prepared MRF-237 and teflon pad onto the transmitter PC board. Liberally goop the MRF-237 with a heat sink compound. Tune the input and output capacitors, Tct2 and Tct1, for maximum power output on the wattmeter. This can be done with the unit apart, observing caution that nothing is shorting. If you have the TR-22C face pointing at you and use the power output transistor as a center of a clock, Tct1 is located at 2 o'clock and Tct2 is located at 8 o'clock. This modification netted a power output increase from 1.3 to 2.2 Watts at 12 V dc. This output transistor change increased transmit current drain from 450 mA to 500 mA.

What can be done with the perfectly good power output transistor you have just removed? Very simple – exchange it with the driver transistor. Simply remove the driver transistor, Q18, located at 1 o'clock from the power output transistor. It might be a little difficult to remove the driver transistor because of the speaker bracket, but it can be done by prying gently on the transistor and using a hot soldering pencil on the bottom of the board. Install the old power output transistor into the printed circuit board where the driver transistor was removed. Tune Tct1, Tct2 and Lt10 for maximum output. Current drain increased to 580 mA. Button up the radio, check the tuning and off you go. Power output now was 3.4 Watts.

What about the batteries? First off you are not going to decrease battery life that much. The Standard SRC-146A draws 630 mA on transmit versus the 580 mA my TR-22C now uses. If you have ever used a TR-22C any

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length of time, you know that they don't last forever on batteries. Besides, we all know that the battery pack was designed to run the radio in an emergency when external power is not available. In emergency operation we keep our transmissions short. We don't ragchew, right? Justification enough for power increase. Increased power also makes a better reason to buy a rubber duckie and save the telescoping antenna.

To help you make it easier to use the TR-22 in mobile, base and portable operation, install a PL-259 to BNC female adapter, and buy the BNC connectors for your coax. I also use a rubber duck antenna with a BNC connector on it which is available from various manufacturers. This makes it easier to move the rig from mobile to base to portable operation. I also use a right angle BNC, so I can set the rig flat and the rubber duckie vertical. It is also nice when using the rig over the shoulder. The antenna is horizontal but away from the body and the body acts as a ground plane.

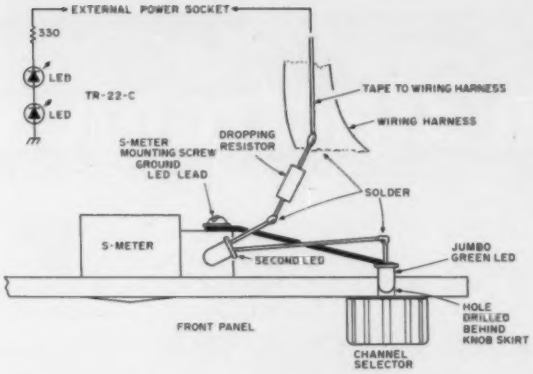

Fig. 2.

My final modification was to backlight the dial on my TR-22C. I drilled a hole in the face plate behind the channel selector knob after it was removed and mounted a jumbo green LED. Be sure the LED does not touch the skirt of the channel selector knob, as it will scratch the channel numbers off the skirt. The LED was suspended by one lead grounded to the S-meter mounting screws. See Fig. 2. A second LED was installed in series with the first, and pointed into the S-meter face from the inside. The primary reason for this was to dissipate some of the voltage drop required so that a ½ Watt current limiting resistor could be used. "This draws more power," you say? Right you are. But if you go to the external power jack you will find that the back terminal on the jack is hot only when external power is applied – and when external power is applied, who cares? Use a voltmeter to find the terminal on the external power jack.

The R. L. Drake Company does not recommend any modifications to its radios; if yours is under warranty, these modifications will void it! After 90 days, it's your radio and you can do what you want. The LED readout is very nice while mobile during night operation. The MRF-237 transistor has passed the "let's kerchunk the repeater to see if it's up" test many times without an antenna. In my experiments, the transistor has withstood the ten second keydown test with no antenna. Probably the collapsed antenna presents some kind of load that saves the device. ■

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I/O EDITORIAL

by Wayne Green W2NSD/1

KILOBAUD?

We've decided on a last minute name change from *Kilobyte* to *Kilobaud*. A high capacity data channel is rated in kilobauds, and the purpose of the new computer hobby magazine is to provide a maximum of data per unit of time. It's a natural.

We did like the name *Kilobyte*, but when a suit was entered by *Byte* we decided that we would prefer to put the money, time and effort into a better magazine rather than a court battle, even though we could see no way to lose. Our business is publishing, not fighting lawsuits. We consider this a frivolous suit, but since the magazine has yet to be published the name is not worth a big hassle.

Kilobaud has no connection with *Byte* or any other computer magazine. If anyone subscribed thinking he was getting *Byte*, the subscription may be canceled.

COMPUTERIZED MORSE

One of the computer mags recently devoted an entire issue to stuff on Morse code via computers . . . and I'd like to have my say on this subject. As usual, opposing opinions are welcome and will be printed if they seem to warrant it.

Just to get off on the right foot with you, I'll say it plainly and simply . . . I think Morse code via computer is a fad and of little real value. Yes, I *know* the arguments. I am quite aware that there are no speed limits on Morse, nor any bandwidth limits (as yet). I also know that one way to get them is to start spraying the ham bands with 1000 wpm Morse which covers X kHz or so. You figure out how wide it would be and put in a number.

No, take it easy . . . relax a little and see what I have to say before getting all upset. Let me take you back twenty years or so to when a small group of us were battling the ARRL to get the FCC to okay FSK (frequency shift keying) for our Teletypes on the low bands. Sure, we could send make-break RTTY if we wanted . . . and a few of us experimented with it extensively. I used to have a wicked signal on 3620 with make-break, and made many contacts using it in those long ago days. I still have that old kilowatt rig down under the cellar stairs.

So, having spent a couple years with make-break RTTY and then many more with FSK RTTY, let me tell you that you can work through a whole lot more garbage with FSK than you can with make-break (CW). How long do you think it is going to be before a whole raft of spoil sports will be geared up to chop computerized Morse code to bits? And they will be able to do it easily. The fact is that it is much more difficult to clobber FSK, particularly if you use some of the better circuits which will run off either mark or space during interference.

Sure, we have to convert to Baudot before transmitting at present, but I'll bet that we can get the FCC to authorize ASCII if we only make an effort, and then we'll have much clearer sailing. Do I hear any serious arguments for CW vs. FSK? I doubt it.

So, to put our money where our typewriter is, I'll say that I am much more interested in Baudot circuits and programs than in Morse for publication in *73*. But please don't let this stop you from peppering the FCC with petitions and letters telling them you *want* ASCII. I tried to get them to give us a Christmas present a year ago of ASCII and was brought up short by the news that *no one* had been pushing for it. Come *on*.

One more item — it is my plan to keep ham-oriented computer material in *73* and non-ham in *Kilobaud*. Any arguments on *that?* I figure that hams will be reading it in *73* and non-hams won't care that much. This is not to say that *Kilobaud* readers won't get a lot of propaganda about how great computers are over the air.

WHITHER I/O?

With *Kilobaud* scheduled out in early December, a lot of readers want to know what is going to happen to the I/O section of *73*. For those of you who missed my answer to that last month: not much. We'll be having a good deal of hardware in I/O for you, while *Kilobaud* will tend more toward software. Reactionaries who have been wishing that computers would just go away are going to be as frustrated about them as the previous generation was over transistors, which just wouldn't go away.

AND KILOBAUD?

Though editor Craig suffered a lot from doubts about our getting enough articles to keep *Kilobaud* going, the fact is that we already have more than enough for the first three issues and articles are coming in two or three a day — good articles! These are articles that are simple enough so even *I* can understand them!

Well, you can't really tell that much about a new magazine until it has been going for about six months, so we'll see how my ideas hold up and if we can deliver what I've promised.

Promises: fun, fundamentals, the opportunity to make money with your hobby, equipment reviews galore, the best communications we can muster for readers and an ongoing library of programs and algorithms.

Like *73*, *Kilobaud* will not be taking itself too seriously. No ego trips or PhD pretensions. We'll try hard to tell it like it is — tell you what we think — and give you a place to argue about it. That's the fun part of it.

Since hardware people need fundamental articles on software and softies need ditto on hardware, we'll try to keep a good part of *Kilobaud* simply written. One measure of this is whether *I* can understand the material or not. There are a lot of things in *Byte* and *Interface* which I don't understand, and so far the feedback is that most of you have found the same thing. An awful lot of us want a magazine we can understand.

Money: Ha! I'll not be satisfied until every hobbyist out there is making plenty of money . . . and it won't be that difficult. I may be able to get you some business programs you can run on your system and handle things for local merchants (a nearby drug store is after us to get our Altair rigged up to keep track of his customer list and prescription numbers — and he'll pay well for the service). Or how about a simple system for printing out portraits at fairs, shows, etc? They sell for $2 or so each and are a snap to make with relatively inexpensive equipment. There are plenty of ways to make money with small computers and we'll be pushing hard to bring you this info.

Well, you get the picture. We think *Kilobaud* is going to be by far the best of the computer magazines — and the widest read. Any magazine that can help you make a few extra bucks (or a few thou) is one you can't refuse.

How many hobbies can you find which will pay off like that?

VISITING AROUND

In August 1975, I made a quick trip around the country visiting the few microcomputer manufacturers . . . Sphere, MITS and Southwest Tech. In August 1976, Sherry Smythe (*73*'s Marketing Manager) and I repeated the trip, this time including Apple, Jolt, M&R, Wave Mate, the Computer Mart, the Byte Shops, and Intelligent Systems, as well as a revisit to the three of the previous year.

Last month I briefly covered our visits to the California and Utah manufacturers. The next stop was Albuquerque and MITS, which is just around the corner from the airport. Ed Roberts is usually busier than a one-armed paper hanger, so I expected at best to get a quick hello as he dashed past. It turned out that we spent the whole day talking and almost missed the plane to San Antonio that evening!

Ed is getting very much involved with ham radio, as are quite a few other computer hobbyists (about 25%). It had not escaped him that a great many hobby computer applications were for ham projects. We talked hamming and hobby computers for hours. I think we are pretty much in agreement about the future possibilities for small computer systems and there is no question Ed is thinking way, way ahead with a lot of the projects he has going.

MITS has settled into the new plant they got this year — quite a difference from the string of small rooms they had last year. The place is very busy, with programmers programming, engineers designing and testing, and the production lines going full blast.

AHA, SAN ANTONE

The next morning Sherry and I visited Southwest Technical Products in San Antonio where Dan Meyer had his new printer up and running. It has the same internal mechanism as the MPI ($450) printer, but comes in kit form for $250. The 40 character line width is a bit limiting, but should be fine for program dumps, label printing, short invoices, etc. I understand that a couple of fellows have already worked up an 80 character modification of the system — this would take a bit of machine work, but should not be too difficult.

The SWT graphics system was up and running, too, and should prove very popular. This is the first step toward being able to run programs like the tank battles you find in the quarter arcades. We also got to see the SWT cassette system in action (uses the Kansas City Standard — I don't feel much like calling it the *Byte* standard). Southwest Tech sure has their act together.

My Chronex watch dimmed and then went out while I was in San Antonio. I didn't realize how much I depended on it. The batteries were supposed to last a full year . . . hey, come to think of it, it was just a year ago I stopped off at the Chronex factory near Dallas and had the batteries put in . . . not bad. We stopped at a shopping center and they had the tiny batteries for sale . . . my watch was running again.

Continued on page 200

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I/O REPORT

by John Craig

The I/O section of *73* is alive and well! (And will continue to be . . . for a long time.) I thought I should mention that, because in my traveling around to clubs, stores and manufacturers, it seems that one of the questions thrown at me the most has been, "Now that you and Wayne are starting *Kilobaud*, what's going to happen to the I/O section in *73*?" The answer is quite simple. *73* is going to continue providing you with over 160 pages each month of the most interesting, most up-to-date, and most *invigorating* material you're going to find in any ham or electronic hobbyist magazine. And, you can bet that the I/O section will continue making its contribution. There are two reasons why the I/O section will continue (in *style*, I might add). First and foremost is the fact that Wayne Green would never be satisfied with having *73* in any position other than *number one*. Needless to say, one of the things that keeps us out in front is the fact that we're usually a couple of years ahead of the other ham magazines . . . and the I/O section with its coverage of amateur microcomputer systems is one of the things giving us the two year jump right now.

The other reason why the I/O section will stick around is because I've got an unending stack of manuscripts for it! Once again, there are two reasons to explain the situation: A lot of hams (and non-hams) will continue to write for I/O because they know they're getting to a large readership (which is something most authors want . . . and is why they'll be writing for *Kilobaud*, too). The second reason is the one which really strikes home . . . *money*. Do you realize that we pay so well? That in most cases you could make enough with one or two articles to *buy a microcomputer?* A lot of the people whose articles you're reading know it. Think about it.

Another question which comes up is, "If I have a subscription to *73* and *Kilobaud* am I going to be reading the same material in both?" We don't have any intention of reprinting articles from one magazine in the other. But, in rare cases, if it's felt that a particularly good article belongs in both, we'll probably run it in both.

MICROSYSTEMS SERVICE ENGINEERS/TECHNICIANS

You know, with over 300 computer stores around the country and the possibility of this whole thing busting wide open in the near future (with small business and/or home systems), the opportunities for getting into the service field *are there*. The parallels between this situation and what happened with the television industry are too close to be ignored. I keep thinking back to 1949 and the TV repair business my dad (ex-W5WVA) started in his garage. He had more business than he could handle, and he was only doing it on a part-time basis to pick up extra cash. (Of course, that isn't too unusual . . . you can do the same thing today if you open a garage TV repair business!) The point is, if he had decided that TV repair was what he wanted to pursue, he would probably have a *chain* of repair shops today. Very soon there will be enough microcomputer systems around to enable a lot of enterprising individuals to get into part-time (and eventually full-time) businesses repairing and maintaining these systems.

Perhaps you're wondering how you could get into something like this? I've got some suggestions. If you want to build up your expertise in this area, you're going to need to get as much experience in troubleshooting as many different kinds of systems as possible. One way to accomplish this would be to let the word out at your local computer club meeting that you would like to get in on the troubleshooting of any problems which crop up among the members. People appreciate help when they're troubleshooting . . . two heads are usually better than one. If you own a good oscilloscope, the chances are that people will occasionally ask to borrow it. Simply go with it.

It certainly isn't going to do to become a "specialist" with the 8080 (for example), and ignore the 6800 and others. As I said before, it will be important to get to know them all as well as you can. Being able to write short little troubleshooting routines to check out (or troubleshoot) a peripheral will be a good thing to concentrate on. Most of the problems of the future very likely will be with peripherals. I'm not too sure that's the case right now, because I've spent some long hours lately troubleshooting the processors of several microcomputers.

Another method for getting a variety of troubleshooting experience under your belt would be to ask the owner of your local computer store if he would mind you getting in on the troubleshooting problems he encounters. Needless to say, you could fall into a part-time job working there after becoming good at it.

I would be willing to bet we're talking about more than just a little part-time cash, though. If this thing takes off and flies in the next few years, there's going to be as much of a need for computer repair shops as there ever was for TV repair shops.

Kind of a side note to this whole thing is the fact that there are quite a few MARK-8 computers out there which don't work, and a lot of people would like to take them down off that shelf and get them running. I'm not too sure you could make a lot of money by getting into the MARK-8 repair business, but if you're interested, drop me a line and I'll tell you how to get in touch with the "MARK-8 world." (For you newcomers, the MARK-8 is the little 8008-based microcomputer that got this whole thing going 2½ years ago.)

SPEAKING OF THE MARK-8 . . .

I have tried (unsuccessfully, until now) to get several MARK-8 owners I know to send me pictures of their systems so that we could include them in the I/O section . . . and satisfy the history buffs among us. Grant Runyan came through. This year Grant retired after teaching high school math for over twenty years. One of the things he did in his last two years was to get quite a few kids turned on to computers (via his MARK-8).

Not only is he making good use of the first hobbyist microcomputer, but he's also using the first hobbyist TV typewriter: the TVT I. The processor is running with 12K of 21202s. He has plans to interface a Flexowriter for hard copy (also as a terminal, I would assume), and the Mathematical Function Unit (calculator chip interface) as described in the September and October '76 *Byte*. The system is a paper tape system, in that he has a Friden punch (not shown) and a home built high speed paper tape reader (shown in the lower photograph).

(A friend of Grant's, Doug Hogg, has an identical system and has written a comprehensive construction article for that reader which will be in an early issue of *Kilobaud*. He'll also be doing a future article concerning that Flexowriter interface. Both of which will interface with *any* system.)

Now you might be asking the question, "What good is an 8008-based system? There isn't a good BASIC around to run on it, and there is very little software that has been developed for it." There is a good 8008 "BASIC" around . . . and it's the Scelbi language called SCELBAL. I say it's "good," but I don't really know . . . I'm just going by what I've heard. Why doesn't someone write an article which would be a critique of Scelbi's SCELBAL? We review new products and books, don't we? Why not new software? Let's find out how it stacks up against other BASICs (by the way, there's an 8008 *and* an 8080

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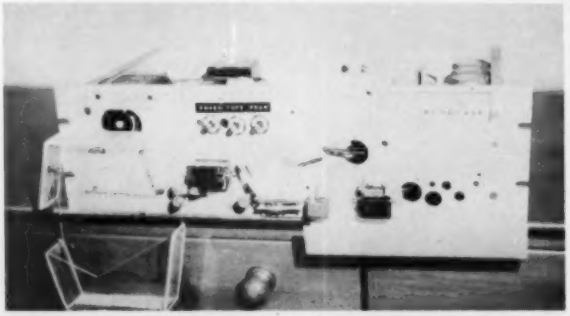

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THE JUPITER IIC KIT: $2850

The kit includes the CPU, software debugger and monitor module, 8K dynamic memory, module cage, power supply, front panel, video interface, cassette interface, and all the documentation required to assemble, run, and understand the system as well as modification instructions for a black and white TV set.

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2 It will help you in many ways to take advantage of the coming bonanza for hobbyists. The $50 million computer hobbyist market of today will be the $500 million small business market of two years from now and the $5 billion market of ten years from now (or a lot less). *Kilobaud* will help you make money.

3 You'll continue to get I/O hardware articles in *73*. *Kilobaud* will be more software oriented, and you'll be needing this info.

4 Computing and hamming go together. There will be a microprocessor in much of your ham gear in another year, so learn about them right now . . . be a pioneer. Were you among the last to change to SSB? How about FM? Did you fight it or did you get in there and pioneer it with your own repeater? Here is another pioneering opportunity for you . . . don't muff it.

5 *Kilobaud* will tell you as much as possible about the hardware being put out. Other magazines have had little about it. Get to know all of the major systems and their plusses and minuses.

6 *Kilobaud* will have a continuing program library. When you want to write a program, it will be duck soup to sit down and take part of this one and perhaps that algorithm . . . and end up with a program that might even work the first time.

7 *Kilobaud* will be the first magazine to bring you detailed letters from hobbyists telling you of the problems they've had with their systems and how they managed to overcome them – invaluable unless you are a big fan of wheel reinventing.

8 The *Kilobaud* lab will have most of the common hobby systems up and running. This means the staff will be able to test new gadgets, programs and systems and let you know their reactions. No other magazine has such a lab.

9 *Kilobaud* is going to be aimed at helping newcomers to computers, so you'll find it easy to come up to speed in this new field.

10 Just as *73* has the top writers of the ham field, *Kilobaud* will be publishing the top computer hobbyist writers. If you know your beans, you will find *Kilobaud* pays about double what most other magazines do for articles (this is one of the reasons why the very best are going to be in *Kilobaud*).

11-20 . . . even better reasons for subscribing to *Kilobaud* . . . wish we had the room here to give them in detail.

21 The Charter Subscription price for *Kilobaud* is only $12 for one year and $25 for three years. Individual copies will be $2. The Charter Subscription is good until December 31, 1976.

22 Note that first copies of *Byte* are selling for more than a year's subscription . . . take heed. A limited number of *Kilobaud*'s first issue will be printed and when they are gone, they will be gone.

23 Better fill out the subscription blank. Charge it.

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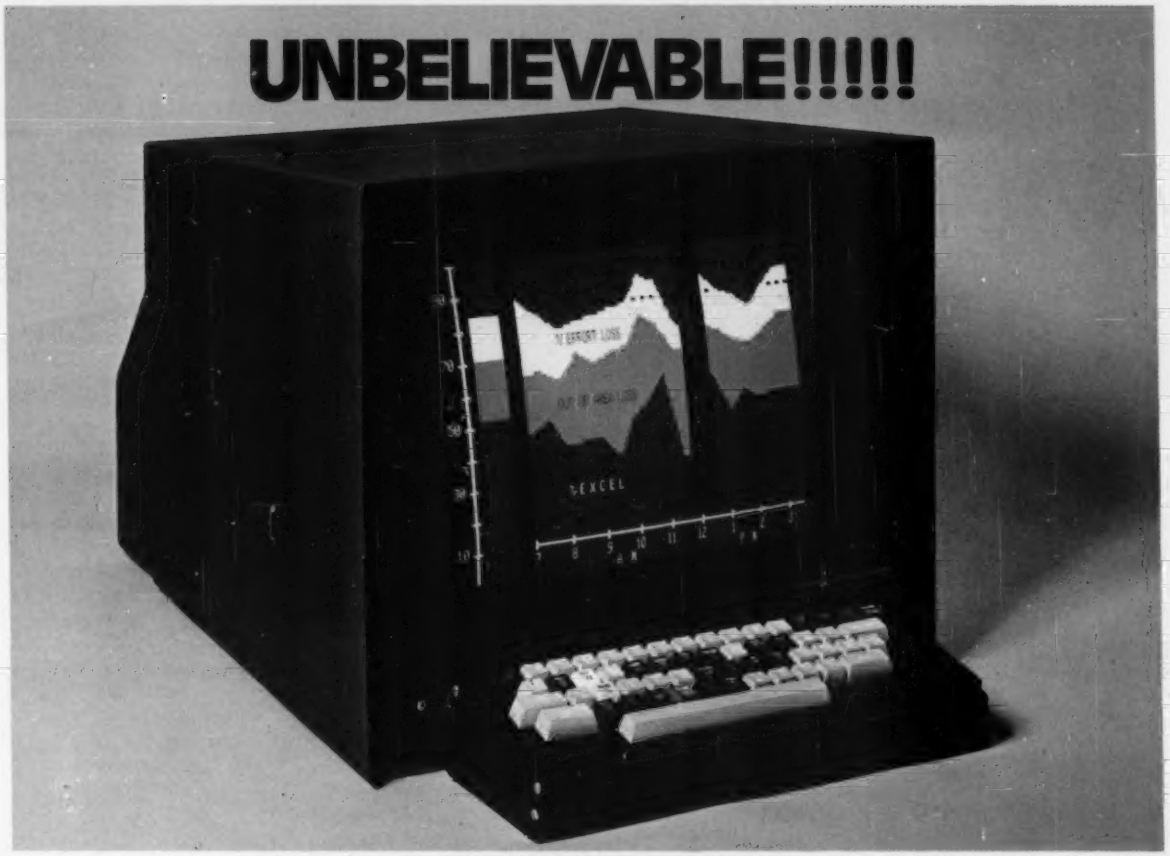

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What Computers Can and Can't Do

-- a look at amateur radio's future possibilities

Knock. Knock.

"It's open. Come on in. Oh, good evening, Bill. What are you doing in this part of town?"

"Evening, Tom. I just, uh, happened to be in the neighborhood and thought I'd drop by and see how you did in the Sweepstakes."

"Oh, I can't complain. I'm a little tired from staying up most of last night, but I had a lot of fun. How about yourself?"

"I had a great time. I got me an automatic CQ sender just for the contest, and it really helped. I made, get this now, 142,730 points."

"Hey, that's real good. That's the best you've ever done, isn't it?"

"Yes it is, Tom. It's the CQ sender that did it. What kind of score did you make?"

"Oh, a pretty good one."

"How good?"

"Well . . ."

"Aaaaw, don't be embarrassed. I won't tell the boys."

"Oh, I'm not embarrassed. I made 387,540 points."

"What? You're kidding!"

"No, actual fact."

"That's more than twice the highest score I ever heard of. You must have figured it wrong."

"No, I didn't, Bill. I just made a few modifications to the station. Would you like to see what I've done?"

"Would I ever!"

"In here. Let me get the light."

"Hey, what are all these funny looking boxes? Are you running 10 kW or something?"

"No, this is just my latest interest, a computerized ham station."

"A what?"

"The price of computers has been dropping and a lot of hams have been getting interested in them. I built a few things and programmed this little computer to make my Sweepstakes operation more efficient."

"How do you mean, Tom? I still can't see how it works."

"Well, this computer works internally with something called ASCII Code. So first I built a Morse code to ASCII converter so that the computer can understand Morse. Then I wrote a microprogram so that the computer could lock on to any code speed by comparing the relative spacing of the dots and dashes. Now I have a computer that I can hook up to my receiver and it can understand any CW signal it hears. Does that make sense?"

"Yeah, I guess so."

"Next I took this old TV set and modified it to use as a display. Now the computer can read CW and print the results on the TV screen for me to read. Then I built two digital sweep circuits, one for my main receiver and one for my spare receiver. Now the computer can automatically sweep through the band, and I've programmed it to copy and store the call, frequency, code speed, and other information such as section, etc., of everyone it hears. And when I'm sending, the computer tunes the receiver to the other end of the band and listens to who's there during the spaces between characters. When I finish transmitting, it zips the receiver back to the transmitter frequency, listens to the other guy's part of the exchange and displays the result on the TV screen. Got that?"

"Wow!"

"Of course, the computer also keeps the log and maintains a check list to make sure that I'm not working the same guy twice. It also retunes the transmitter for the part of the band I'm in, and, of course, it points the beam in the direction of the guy I'm talking to. Oh, and you remember that I said that I'd built two frequency sweeping circuits and that one was for the spare receiver? While I'm working people on one band, say 40 meters, the computer is using the spare receiver to listen to 80, 20, 15 and 10 and to keep track of who's on, what frequency they're on, their section, and approximate code speed. It also keeps track of band conditions so that if 20 gets real good, for example, I don't waste my time on another band that isn't as active."

"Wow!"

"Of course, I programmed the computer with all of the sections. For the first 3 hours of the contest I just worked as many stations as I could. After that, the computer kept a special watch for the sections that were missing."

"Wow!"

"But let me describe a typical QSO for you, Bill. The computer would print on the screen: 'W1XYZ 7033.28 KHZ 16 WPM CT SEC.' From the way I had programmed the machine, I knew that W1XYZ had just called CQ SS, that he was on 7033.28 kHz, that he was sending at

about 16 wpm, and that the computer had previously copied his section as CT. I also knew that I hadn't worked him before or the computer wouldn't have printed his call on the screen. I'd hit this button on the console labeled GET HIM, the computer would zip the transmitter to 7033.28 kHz, switch to the dummy antenna and retune, and a few milliseconds later, while aiming the beam at Connecticut, send at 16 wpm: 'W1XYZ DE WB6OBS K'. If he came back to me, the computer would print his response on the screen while I listened to it for verification: 'WB6OBS DE W1XYZ NR 1 A W1XYZ 55 CT BK'. The computer would print on the screen and start sending: 'BK QSL NR 50 A WB6OBS 64 SD BK'. The computer would print W1XYZ's response while I listened: 'BK QSL GL CQ SS . . . '. As soon as I saw and heard that, I hit this other button here labeled LOG IT, and the computer would log the call, time, frequency, exchange, etc., as required. If the other guy missed anything, the computer is programmed to respond to requests for a repeat of CALL, PRECEDENCE, NR, CK, or SEC. If anything else was needed or if the computer didn't understand what was missed, it would print a line of question marks on the screen: '????????????' and turn control to manual. That meant that I would have to take over and complete the exchange and log it manually. Then I would turn control back to the computer. Of course, I could hit the MANUAL button any time I wanted to make changes or corrections to the exchange or to the log entry. Interesting little system, eh Bill?"

"Fantastic! Unbelievable! I feel like I'm in the year 2077 rather than 1977 like I know I am. I see how you made that high score now. Wow! . . . A couple of things do bother me, though."

"Yeah, like what?"

"Well, I don't see how anybody can compete with a computerized station like yours unless he's got one like it. Does this mean we all have to computerize or give up contests?"

"No, Bill, I figure that within a year or two there will either be a separate category and computerized stations will only compete with each other, or there will be a multiplier for non-computerized stations, like one for low power, to give everybody an equal chance. Anything else?"

"Well, it looks like the computer did everything. It looks like you could have turned it on and gone to bed. It doesn't seem much like ham radio to me. Do we all computerize our stations and then sit back on our hands while the computers talk to each other?"

"I thought about that too, Bill, but I don't think so. First, all of the things the computer did were things that I wish I could do myself. I wish that I could listen to and remember all the calls and frequencies and sections from one end of every band to the other, but I can't. This computer can, so why not use it? I wish that I could generate rf in my brain and send and receive it with no additional equipment. I can't, so I use a transmitter and a receiver and an antenna. They do the things I can't do, just like you use your new CQ sender to call CQ while you're logging, because you can't do both things at once without it."

"But it doesn't seem quite human somehow, and I like the human touch in my QSOs."

"I like the human touch in my QSOs too. When I'm not using the computer here for contests, I use it to make my QSOs more satisfying. I keep a more detailed log with it than I ever could with pencil and paper. If a guy tells me that he's a retired mailman and that he now builds model airplanes and lives on a houseboat, I record all of those things in my computer log. If I work the same guy again in three months or three years, I wish that I could remember all of those things. I can't, but my computer log can, and all I have to do is type in the guy's call and a question mark and hit the ENTER key, and if I ever talked to him before, I know it in about 2 seconds and I know everything I ever logged about him because the computer prints the log entry and information on the screen."

"I think I see what you mean, Tom. Use the computer to do things you can't do and to make your operating more enjoyable. It would be great to keep a watch for those rare DX stations, and it could keep watch day and night, on all bands."

"Yeah, that's the kind of thing I mean. You could even have it keep watch for specific calls, so that if an old friend of yours got on the air you would know it immediately. Or it could automatically aim your antenna at a satellite and follow it across the sky. The possibilities are almost unlimited."

"It sounds great, Tom. You've sure sold me. All of this gear must have cost a fortune though."

"I told you that the price of computers and computer memory was dropping fast, right?"

"Right."

"All of the computer gear you see here cost me about $400. It's mostly used gear and surplus, and some of the interface stuff is home brew. I probably spent six months getting everything together and getting it working, though."

"That's not too bad. I have just one last question, Tom."

"What's that?"

"Do you know anybody who wants to buy a slightly used automatic CQ sender?" ■

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80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
**80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

NOTES
1. Models prefaced ' ** ' will be available 1/77.
2. All models above are furnished with crimp/solder lugs.
3. All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
4. 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3850 kHz. See VSWR curves for other resonance data.

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Dr. George L. Haller W4BQ
Hound Ears Club
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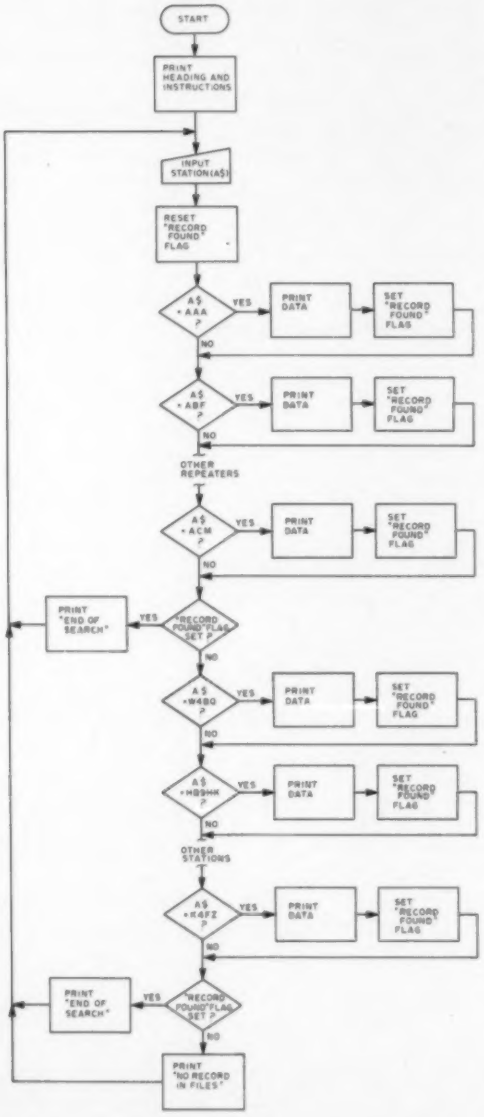
A Ham Shack File Handler

-- program in BASIC for QSLs, repeaters, etc.



Program flow chart.

This article describes a simple program in BASIC which will keep track of your QSLs and also give you information on the repeaters that you may wish to use. The program may also be extended to provide other functions in logkeeping, but it was kept simple to give the hams who are new computer freaks a chance to get acquainted with their new toy. It is written in Altair BASIC version 3.2, but could be easily modified to any other BASIC.

A SAMPLE RUN OF THE HAM FILE

```
RUN

REPEATER AND QSL FILE

FOR REPEATERS USE LAST THREE LETTERS OR FREQUENCY AS 13/73
OR CITY NAME, FOR AMATEUR STATIONS USE COMPLETE CALL.

STATION ? AAA
WR4AAA, 13/73, 190, SALISBURY, NC.

END OF SEARCH

STATION ? 28/88
WR4ABF, 28/88, 195, SHELBY, NC

END OF SEARCH

STATION ? HICKORY
WR4ACM, 25/85, 195, HICKORY, NC

END OF SEARCH

STATION ? ABQ

NO RECORD IN FILES

STATION ? CR6CA
5/26/71, 0015Z, 14MHZ, RTTY, JOE

END OF SEARCH

STATION ? K4GV
11/6/75, 0710P, 2M-FM, TED
12/5/75, 0655P, 2M-FM, TED

END OF SEARCH

STATION ? W2ABC

NO RECORD IN FILES

STATION ? W4BQ
THAT'S YOU, STUPID!

END OF SEARCH

STATION ?

OK
```

Station Operation

A sample readout shows that information about a repeater can be obtained by replying to the initial question of the computer ("STATION?") with the last three letters of the repeater call, such as "AAA" or by typing in the frequency pair as "37/97", or even by typing in the location city as "SHELBY." If your input is a city name, all the repeaters in that city will be printed and the same goes for the repeater frequency pairs, but only one repeater will be printed for each call. If you should be working in an area which crosses district boundaries, and the same last three letters have been assigned to repeaters that you work, then the identifier should be expanded to include the district number (e.g., "3AAA" and "4AAA").

For information from the log on amateur QSLs, the "STATION?" request is followed by typing in the full call of the amateur station.

After the computer prints the information on repeaters or amateur stations, it will print "END OF SEARCH" and then return to "STATION ?" for the next request. If the requested information is not in the file, the computer will print "NO RECORD IN FILES" and go back to "STATION ?"

The Program

Additions or deletions to the file are accomplished by using the Altair BASIC command "CLOAD," which brings the program into the computer from cassette. A new entry is made by simply adding a new line for each new station, repeater, or even additional QSLs with a previously logged station. After the updating has been performed, the program is then put back on cassette using the "CSAVE" command.

The memory required for the listing shown takes about 1250 bytes and a typical entry takes about 45 bytes. The program could be expanded to provide readouts for summaries of QSLs by districts or foreign countries. This could be done by adding an "OR" phrase as was done in the repeater section of the program, but as mentioned at the start, this program has been kept simple. However, it is a practical operating program and is in use at my station. The listing as shown shows only a small portion of my log files. ■

```
LIST
5 REM HAM FILE IN ALTAIR BASIC BY GEORGE L. HALLER
10 PRINT:PRINT
20 PRINT "REPEATER AND QSL FILE"
30 PRINT
40 PRINT "FOR REPEATERS USE LAST THREE LETTERS OR FREQUENCY AS 13/73"
50 PRINT "OR CITY NAME, FOR AMATEUR STATIONS USE COMPLETE CALL."
60 PRINT:PRINT
70 INPUT "STATION ";A$
80 F=0:REM RESET "RECORD FOUND" FLAG
100 IF A$="AAA" OR A$="13/73" OR A$="SALISBURY" THEN GOSUB 300
110 IF A$="ABF" OR A$="28/88" OR A$="SHELBY" THEN GOSUB 310
130 IF A$="ACM" OR A$="25/85" OR A$="HICKORY" THEN GOSUB 330
280 IF F>0 THEN 1000:REM IF REPEATER IS FOUND
290 GOTO 400 :REM JUMPS REPEATER SUBROUTINES
300 PRINT "WR4AAA, 13/73, 190, SALISBURY, NC.":F=1:RETURN
310 PRINT "WR4ABF, 28/88, 195, SHELBY, NC":F=1:RETURN
330 PRINT "WR4ACM, 25/85, 195, HICKORY, NC":F=1:RETURN
400 IF A$="W4BQ" THEN PRINT "THAT'S YOU, STUPID!":F=1
410 IF A$="HB9HK" THEN PRINT "7/20/73, 2030Z, 14MHZ, RTTY, WILLY":F=1
420 IF A$="CR6CA" THEN PRINT "5/26/71, 0015Z, 14MHZ, RTTY, JOE":F=1
430 IF A$="OA4BR" THEN PRINT "7/3/74, 0915Z, 14MHZ, RTTY, ZIP":F=1
440 IF A$="JH1TFF" THEN PRINT "5/27/74, 1150Z, 14MHZ, RTTY, DOC":F=1
450 IF A$="KJ6BZ" THEN PRINT "7/6/73, 0200Z, 14MHZ, RTTY, GEORGE":F=1
460 IF A$="K4GV" THEN PRINT "11/6/75, 0710P, 2M-FM, TED":F=1
470 IF A$="W4MYG" THEN PRINT "11/3/75, 0725P, 2M-FM, RAY":F=1
480 IF A$="K4GV" THEN PRINT "12/5/75, 0655P, 2M-FM, TED":F=1
490 IF A$="K4FZ" THEN PRINT "2/17/76, 0430P, 14MHZ, SSTV, BOB":F=1
1000 PRINT
1010 IF F>0 THEN PRINT"END OF SEARCH":GOTO 60
1020 PRINT "NO RECORD IN FILES":GOTO 60
OK
```

Heading & Instructions

Input Station Request & Reset "Record Found" Flag

Repeater Recognition Symbols

Repeater Subroutines (The number after the frequency pair is the antenna direction bearing from my station)

Station QSL Compare Routines

Robert S. Hatch, Jr. W0TBL
Route 10
Columbia MO 65201

Print Your Own Log Book

- - on your nearest computer

Several days ago, we stopped in at the local ham store to purchase a log book. And, to our amazement, the ARRL Log Books were priced at $2.00 each. We felt that something had to be done to help combat this inflation, so we decided we could print our own logs on the computer at work. Agreed, not everyone has access to an IBM 370 Model 165 and 155 back to back. However, there are a lot of computers around, and who knows, the guy down the block just might run the program for you.

The program was written in Fortran IV because of simplicity, and can be compiled by a large number of computers.

The computer program is punched into IBM cards on an IBM 029 Keypunch. The JCL (Job Control Language) was not included because each computer installation has its own unique JCL. And, you will need to know the JCL at the particular computer site you use.

So why not punch up the program, find a computer, and run off several thousand log sheets on that idle computer? ■

Editor's note: The author is selling this program deck for $4.00 postpaid.

```
$JOB
1       DO 9 M=1,15
2         WRITE(6,1)
3       1 FORMAT('1')
4         WRITE(6,2)
5       2 FORMAT(' ',130('-'))
6         WRITE(6,3)
7       3 FORMAT(' ',|     AMATEUR RADIO STATION LOG OF WAYNE GREEN
         1          CALL   W2NSD/1          TIME IN GMT',33X,'|')
8         WRITE(6,2)
9         WRITE(6,4)
10      4 FORMAT(' ',| DATE &  | STATION  | CALLED   | HIS      | MY       | FR
         1EQ.    | MODE      | POWER | TIME     | COMMENTS',22X,'| QSL |')
11        WRITE(6,5)
12      5 FORMAT(' ',| TIME     | CALLED   | BY       | RST      | RST      |
         1          |           | WATTS | ENDED    |',31X,'| SIR |')
13        WRITE(6,2)
14        DO 7 K=1,24
15        WRITE(6,6)
16      6 FORMAT(' ',|          |          |          |          |          |
         1          |           |       |          |',31X,'|   |   |')
17      7 WRITE(6,2)
18      9 WRITE(6,8)M
19      8 FORMAT(/' ',' PAGE',I5)
20        WRITE(6,1)
21        STOP
22        END
$ENTRY
```

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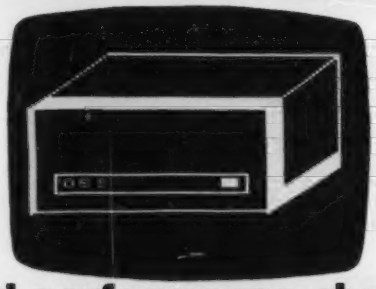

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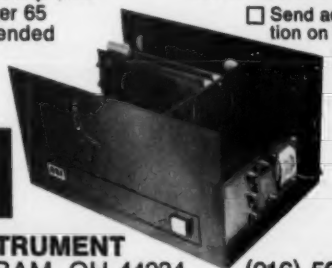

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The Bit Explosion

-- 8 vs. 12 vs. 16 vs. ?

Why settle for eight bits? If you're thinking of building your own microcomputer, take a quick look at what's available before plunging in. For slightly more than what you would expect to pay for an 80-bit CPU chip, you can now get a 12- or 16-bit microprocessor with many more capabilities and features. Those currently available include the 12-bit CMOS chip from Intersil (IM-6100) and Harris Semiconductor (HM-6100) which executes the same instruction set as the Digital Equipment PDP-8/E minicomputer and the 16-bit CPUs from Texas Instruments (TMS-9900), National Semiconductor (PACE), and General Instruments (CP-1600). If you think you're not ready to design your own custom system, several of these companies offer various boards and systems all ready to go.

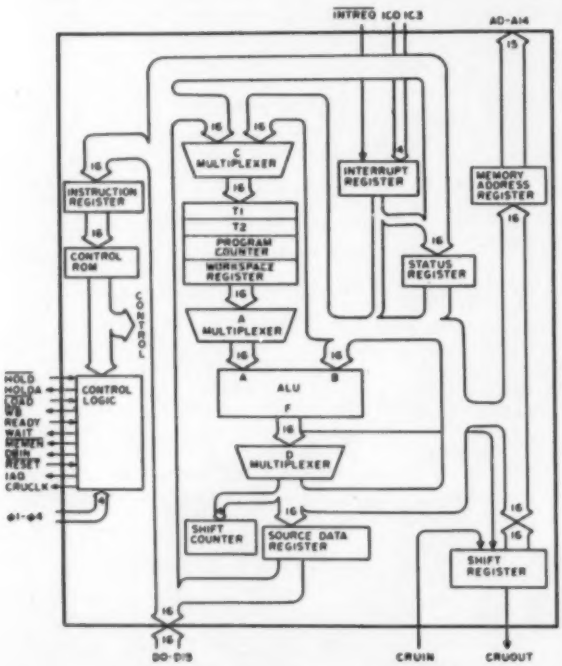

Fig. 1. TMS-9900 block diagram.

The 12-Bit 6100

The IM-6100 from Intersil and the HM-6100 from Harris Semiconductor are pin-for-pin compatible 12-bit microprocessors in 40 pin dual-in-line packages. Both recognize the standard instruction set of the Digital Equipment PDP-8/E minicomputer but cannot accept the Extended Arithmetic Element (EAE) or User Flag (UF) options. Normal memory addressing capacity is only 4K but may be extended to 32K via an Extended Memory Control element. The bus structure of the 6100 can be adapted to provide a subset of the PDP-8/E OMNIBUS signals allowing all PDP-8/E *programmed I/O* interfaces to operate with the 6100 without hardware or software modifications.

The CMOS processor chip requires only a single voltage supply between 4 and 11 volts and is TTL compatible with a 5 V supply. There is a built-in crystal controlled oscillator, for system timing, with a maximum frequency of 8 MHz with selected versions of the chip. All control signals are produced by the CPU chip and can interface with up to 64 separate I/O devices with PDP-8/E compatible interfaces. Other features include single clock/single instruction capabilities, Direct Memory Access (which is not PDP-8 compatible), interrupts, and dedicated control panel features.

The 6100 does require slightly more support hardware than the simpler 8-bit microprocessors, but its software compatibility with the PDP-8 should make the extra effort well worthwhile. Over a thousand fully developed and documented programs are available from Digital Equipment Corporation, Software Distribution Center, 146 Main Street, Maynard MA 01754. Other user generated programs are available from the DEC User's Society (DECUS) at Parker Street, Mail Stop PK-3/E55, Maynard MA 01754. Besides the usual loaders, assemblers, editors, and other utility programs, you can also get various versions of BASIC and FOCAL or even a complete PDP-8 operating system software package. For added troubleshooting convenience, the complete set of processor, memory, and terminal diagnostic programs for the DEC PDP-8 can also be used with the 6100. This last feature, the ability to run various diagnostic programs, is lacking in most microprocessors/microcomputers currently available.

The 16-Bit Offerings

The TMS-9900 from Texas Instruments provides a unique approach in microsystem design using a memory to memory architecture with multiple register files resident in memory, similar to some large scale computers. It's available as a single chip, a complete board (similar to the DEC LSI-11), or a complete system; each has hardware multiply and divide as a standard feature. The rather large 64 pin dual-

in-line package requires ±5 V and +12 V supplies along with a four-phase 3 MHz clock. Fig. 1 gives a block diagram of the internal architecture of the TMS-9900.

The maximum addressable memory space is 64K 8-bit bytes or 32K 16-bit words. The first 64 words of memory are reserved for interrupt and trap vectors while the last two memory words are used for the LOAD signal trap vector. The remaining memory space may be used for programs, data, or workspace registers as desired.

The only three internal hardware registers accessible to the user are the program counter (PC), the status register (ST), and the workspace pointer (WP). The workspace pointer points to the starting address of a 16 register workspace resident anywhere in the external memory space. Each workspace register is addressed by an offset from the current workspace pointer, and the various registers may be used as desired except for a few that have fixed uses as part of subroutine and interrupt linkage conventions.

The CPU provides up to 16 different interrupt levels with level Ø reserved for the RESET function. A built-in Communications Register Unit (CRU) allows up to 4096 I/O bits in fields of 1 to 16 bits in a unique command-driven I/O interface. This interface allows implementing interfaces with exactly the right number of data bits required for a particular application. Other timing and control signals provide capabilities for ROM loaders, front panel service, CPU hold, slow memory cycles and DMA transfers. Of the 66 general instructions, 5 provide a means of initiating user implemented external functions for special applications.

Fig. 2 shows a block diagram of the PACE microprocessor from National Semiconductor, a 16-bit microprocessor in a 40 pin dual-in-line package. The PACE provides four 16-bit general purpose working registers along with a 16-bit status and control flag register that automatically preserves the system status. Return addresses for subroutines and interrupt servicing are automatically saved on a ten word last-in, first-out stack which may be expanded through software via stack full/stack empty interrupt routines. There is a six level, vectored priority interrupt system with individual interrupt enables in the status register for each level as well as a master interrupt enable for the five lower levels as a group. For direct processor status and control functions, there are four sense inputs and four control flag outputs to the CPU chip itself.

The instruction set consists of 45 instructions in eight classes. Memory reference instructions utilize an addressing scheme that provides three floating memory pages and one fixed memory page of 256 words (16-bit) each. The maximum addressable memory size is 64K words of 16 bits each.

Several support chips are available for PACE which are designed to interface directly with the microprocessor chip and thus simplify system design. The System Timing Element (STE) provides the required MOS clock signals as well as an optional TTL clock. The Bi-directional Transceiver Element (BTE) provides single chip, 8-bit I/O buffering between TTL devices and the PACE MOS I/O lines. The remaining support chips include an Address Latch Element (ALE) and an Interface Latch Element (ILE) that may be needed for more complex systems.

For more complete information, sample system diagrams, and applications, refer to the PACE Technical Description available from National Semiconductor (publication #4200078A).

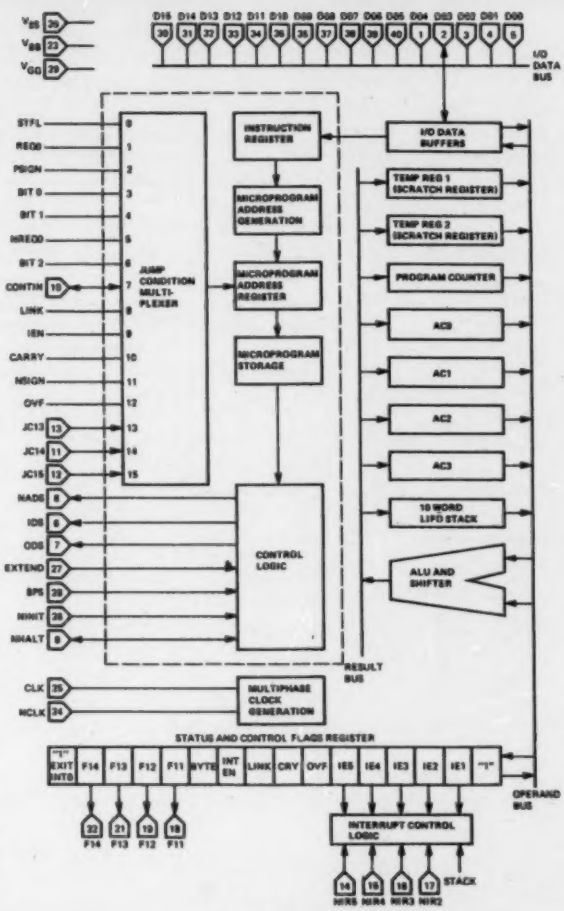

Fig. 2. PACE microprocessor functional block diagram.

The CP-1600 from General Instruments is a single 40 pin chip, 16-bit MOS LSI microprocessor that closely resembles a Digital Equipment PDP-11 in architecture (see Fig. 3). There are eight general purpose, 16-bit registers with R6 reserved as the stack pointer (SP) and R7 as the program counter (PC) just as in the PDP-11. Unlimited stack depth and self-identifying nested interrupt and subroutine capabilities are provided by the stack pointer in conjunction with external RAM memory.

Instruction execution times range from 1.6 to 4.8 microseconds with a 2-phase, 5 MHz clock. Four addressing modes combined with a 16-bit word length allow direct addressing of 64K bytes or 32K words of memory or peripheral devices. Memory and peripheral interfaces are intermixed in the same address space as desired, and all I/O operations may use any of the 87 available general purpose instructions. For special applications, the Branch on External Condition (BEXT) instruction allows direct testing of up to 16 external digital signals.

The main difference between the CP-1600 and the PDP-11 is that the CP-1600 instruction word format is only 10 bits long in the lower order bit positions of a 16-bit processor word. The higher order 6 bits are ignored; thus only 10-bit wide ROM memory is needed where ultimate ROM bit efficiency is desired for particular applications.

For complete information

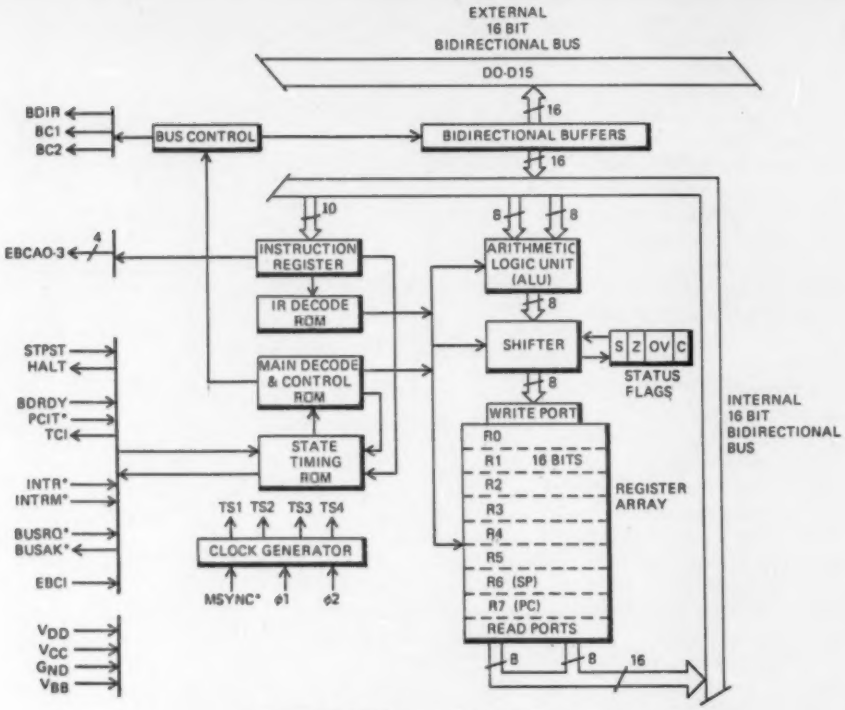

Fig. 3. CP-1600 internal block diagram.

on the CP-1600 CPU chip showing timing diagrams, programming information, and system configurations, the Series 1600 Microprocessor System Documentation is available from General Instruments for $20.

Conclusion

In closing then, you can readily see that the microprocessor world is not limited to simple 8-bit systems and that some of the larger chips are very attractive from the hobbyist point of view in building a new system from the ground up. The prices currently range from about $30 to over $100 in small quantities, but should continue to drop as more interest develops and second-sourcing becomes more common.

So why build an 8-bit machine and wish you could do more, when 12 or 16-bit CPUs are currently available at reasonable prices with many expanded features? Keep in mind that the larger word size machines make higher-level languages more powerful and easier to implement if you don't intend to write all your programs in machine language – and who in their right mind would? ■

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ADDRESS	INSTRUCTION	COMMENTS
A04A	CE	LOAD INDEX REGISTER IMMEDIATE
A04B	00	
A04C	00	
A04D	6F	CLEAR MEMORY (INDEXED)
A04E	00	
A04F	08	INCREMENT INDEX REGISTER
A050	20	BRANCH ALWAYS
A051	??	RELATIVE ADDRESS TO BRANCH BACK TO A04D

Fig. 1. Sample program containing a backward branch.

Thomas H. Hunter
8991 Knoll Street
Allison Park PA 15101

Backward Branch the Easy Way

- - for the 6800

"I have this 6800 machine language down pretty well, but I keep getting software bugs and it's always because of a lousy *backward branch!*"

Sound familiar? I don't know of anyone with a 6800 system who doesn't have this problem. Machine language programming the 6800 can be quite simple ... until you have to calculate a backward branch!

The book says to add 2 to the present location (in hex), then subtract from that the destination address (in hex), and then take two's complement of the result as the address to use. If you have trouble with that, don't feel bad. I can't get it to come out right, either. What I have done is make up the accompanying chart which is now nailed to the wall over my desk.

It is simple to use. Consider the example given in Fig. 1, a program to clear all memory. In order to branch from A050 back to A04D, count (in decimal) from the address of the branch instruction (A050) to the target address. In this case you would count A04F, A04E, A04D — three addresses. Examine Fig. 2 and appreciate the "rain dance" necessary to calculate the address on paper. Look up 3 in the "Count" column of the table (Fig. 3), and then find the corresponding number in the "Use" column (in this case, FB). Quite a difference in effort, huh?

The situation is enough to make a person appreciate an *assembler* ... which would take care of calculations such as this. ■

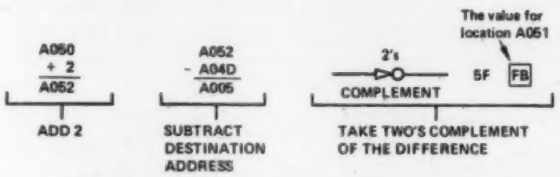
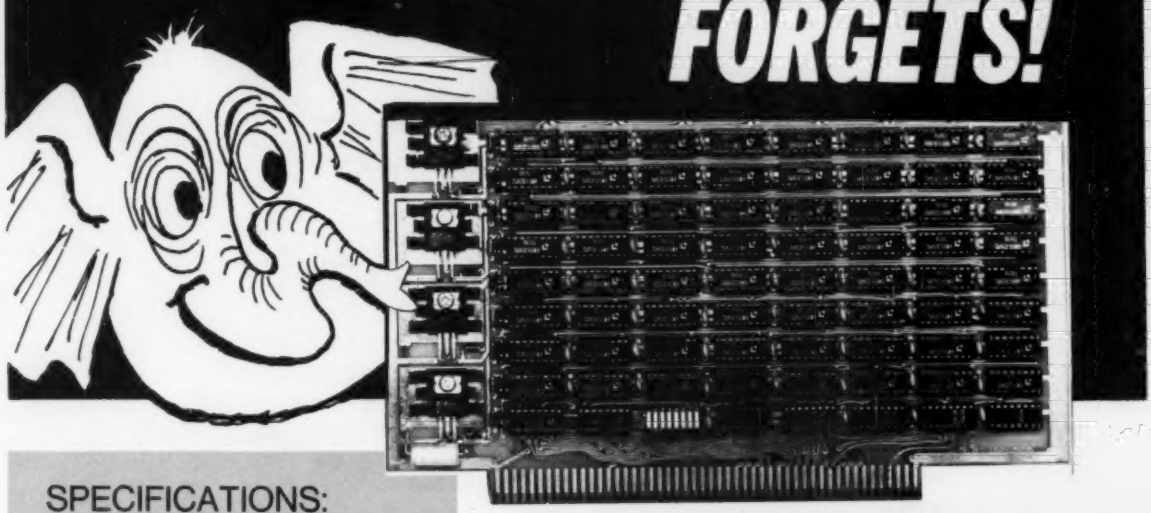


Fig. 2. The "not-so-easy algorithm" worked out on paper.

COUNT USE	COUNT USE	COUNT USE	COUNT USE	COUNT USE
1 – FD	26 – E4	51 – CB	76 – B2	101 – 99
2 – FC	27 – E3	52 – CA	77 – B1	102 – 98
3 – FB	28 – E2	53 – C9	78 – B0	103 – 97
4 – FA	29 – E1	54 – C8	79 – AF	104 – 96
5 – F9	30 – E0	55 – C7	80 – AE	105 – 95
6 – F8	31 – DF	56 – C6	81 – AD	106 – 94
7 – F7	32 – DE	57 – C5	82 – AC	107 – 93
8 – F6	33 – DD	58 – C4	83 – AB	108 – 92
9 – F5	34 – DC	59 – C3	84 – AA	109 – 91
10 – F4	35 – DB	60 – C2	85 – A9	110 – 90
11 – F3	36 – DA	61 – C1	86 – A8	111 – 8F
12 – F2	37 – D9	62 – C0	87 – A7	112 – 8E
13 – F1	38 – D8	63 – BF	88 – A6	113 – 8D
14 – F0	39 – D7	64 – BE	89 – A5	114 – 8C
15 – EF	40 – D6	65 – BD	90 – A4	115 – 8B
16 – EE	41 – D5	66 – BC	91 – A3	116 – 8A
17 – ED	42 – D4	67 – BB	92 – A2	117 – 89
18 – EC	43 – D3	68 – BA	93 – A1	118 – 88
19 – EB	44 – D2	69 – B9	94 – A0	119 – 87
20 – EA	45 – D1	70 – B8	95 – 9F	120 – 86
21 – E9	46 – D0	71 – B7	96 – 9E	121 – 85
22 – E8	47 – CF	72 – B6	97 – 9D	122 – 84
23 – E7	48 – CE	73 – B5	98 – 9C	123 – 83
24 – E6	49 – CD	74 – B4	99 – 9B	124 – 82
25 – E5	50 – CC	75 – B3	100 – 9A	125 – 81

Fig. 3. The 6800 machine language branch chart.

The first 8-K that NEVER* FORGETS!



SPECIFICATIONS:

8K SC - 8 Specifications:

Access Time:	500 ns Max. (225 max on request)
Current Req:	Less than 200 ma per 1024 words maximum
Memory Chip:	AMD 91L02 APC (low power 1K x 1)
Voltage Supply:	+5 to +10 volts
Battery Standby:	1.5 to 2 Volt, Automatic power loss sensing circuit. Eliminates need for switches.
Address Select:	8 ea. Spst. switches in a Dip IC package. (No longer any need for a soldering iron to change address.)
+5 Volt regulated:	4 ea. 7805 regulators with individual heat sinks to run cooler.
Wait States:	NONE! Your wait light will not burn because of a memory wait state.

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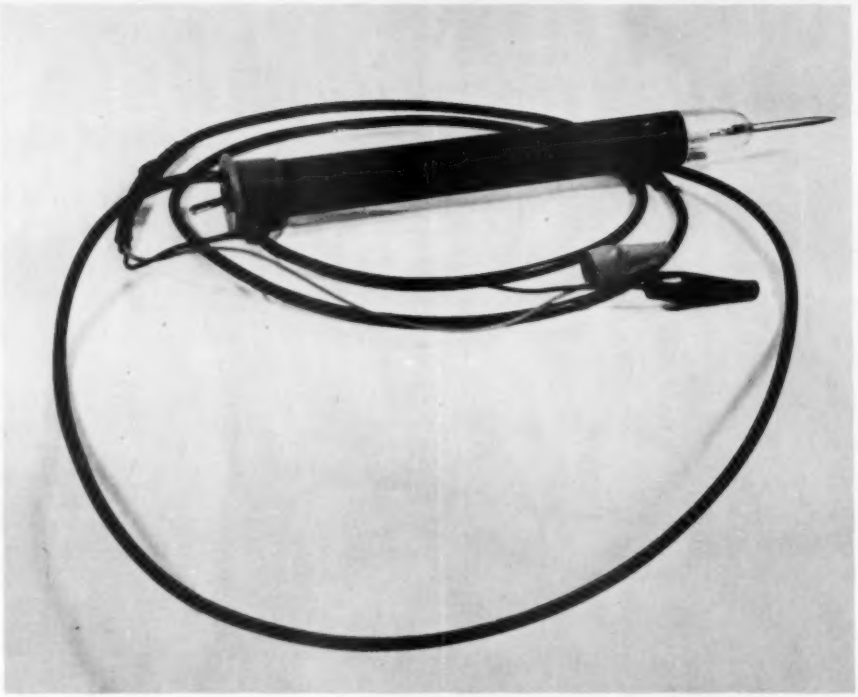
The Superprobe was designed to be an inexpensive piece of test gear which will provide the necessary insight into the digital circuit under test. This probe is not a toy, and will provide the user with almost as much information as a $3,000 oscilloscope, when dealing with TTL or DTL logic.

The probe has several desirable features, aside from the expected "1" and "0" indication. The first is a pulse stretcher, and pulse memory.



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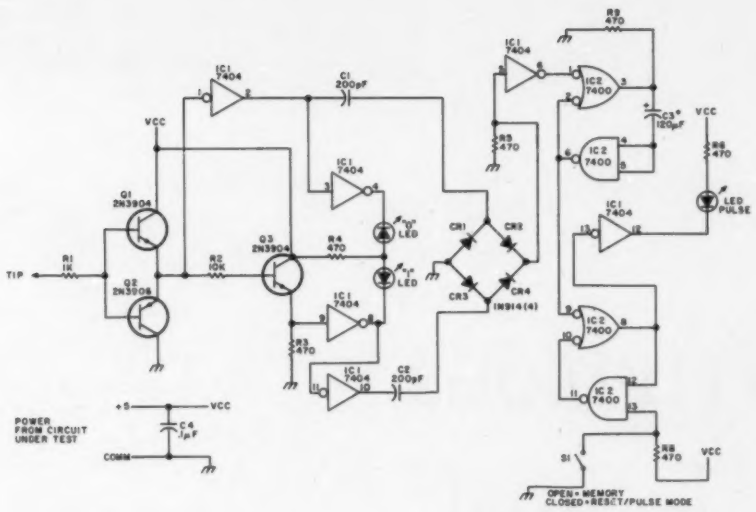


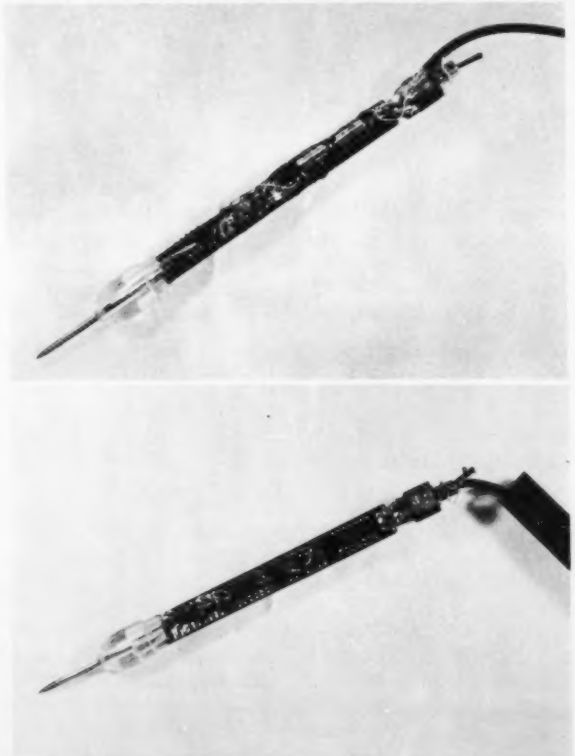
*Fig. 1. The Superprobe. *Note: C3 is two small 60 uF caps wired in parallel.*

Any time a high to low or low to high transition takes place, the "pulse" LED will flash. The flash will be visible even with very narrow pulses, since the probe will stretch the pulse width to a visible flash. If the probe is in the memory mode, the pulse LED will remain lit until reset by the operator, capturing any stray pulse. Another important feature is high impedance input. It will not load the circuit under test. The input is protected by the zener action of the input transistors, with current limited by R1, in the event the probe is touched to high voltage.

Yet another feature of this probe is that if the tip is touched to an open circuit, or to a chain of floating inputs, no light will light, thus identifying this condition immediately. The entire circuit uses only two inexpensive TTL ICs, three transistors, and can, as seen in the photo, he built into a handy, hand-held probe. The unit shown was built by W6ILT. On this very fine unit, Carl used a section of fiber tube for the body, and cast a tip using casting resin (with a glass cigar tube as a mold). A bit of polishing, drilling, and handwork gives his probe a professional look. The wire coming out of the top of the unit is for power, which is taken from the unit under test. ■

Parts List

IC1 – SN7404 IC
IC2 – SN7400 IC
Q1, Q3 – 2N3904 transistor
Q2 – 2N3906 transistor
CR1, 2, 3, 4 – 1N914 diode
R1 – 1k ¼ Watt resistor
R2 – 10k ¼ Watt resistor
R3-9 – 470 Ohm ¼ Watt resistors
C1, C2 – 200 pF capacitor
C3 – 120 uF capacitor (2 small 60 uF in parallel)
C4 – .1 uF disc capacitor
LED 1-3 – Any type/color LED desired



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The Frumious Hexadecimal! Beware!

- - for 16-fingered folk

By this time words like octal, binary, and decimal, plus phrases like base two or base ten have liberally penetrated the consciousness of any *73* reader. The sign of the I/O stands a good chance of becoming the thirteenth sign of the zodiac for many hams.*

For those so afflicted, here is one more number base family to shake hands with. Hexadecimal or base 16 (hexa meaning six and decimal meaning ten ... the sum thereof being 16) has a unique quality in that its symbology uses both numbers and letters.

The first ten states are conventional, using the number symbols 0 through 9. The next six symbols in order are A, B, C, D, E, F. These six alpha characters represent number symbols for values 10, 11, 12, 13, 14, 15.

If you encounter this number family in computer literature, you will generally find that hexadecimal is indicated in one of two general ways. H '10' might be one general form. The alternate form drops the H but keeps the single quote before and after the number, '10'.

The place values for hexadecimal, as might be expected, rise rather rapidly due to the fact that we are dealing with base 16.

Confining our discussion to whole numbers, the value of the rightmost figure of any hexadecimal expression ranges from 0 to 15, this compared to 0 and 1 for binary, 0 to 9 for decimal, and 0 to 7 for octal notation.

In a two digit hexadecimal expression, we can see the rapid escalation of values. Any digit in the column to the left of the first digit is multiplied by 16 to get its absolute value.

As an example, H '3A' is numerically the sum of A which equals 10, plus 3 times 16 or 48. Thus H '3A' equals decimal 58.

H 'FF' would similarly be computed as the sum of 15 added to 15 times 16. This would equal decimal 255.

If we consider four place values of hexadecimal in the same mathematical fashion as we consider decimal, binary or octal, they would form the usual series:

$$16^3 \quad 16^2 \quad 16^1 \quad 16^0$$

Thus by the time we got something like this, H '3A7B', its decimal value, computed as follows, really climbs.

The value of 'B' is decimal 11.

The value of '7' is 7 times 16 or decimal 112.

The value of 'A' is 10 times 16^2 or decimal 2560.

The value of '3' is 3 times 16^3 or decimal 12,288.

The value of the entire expression is 14,971. If you want some exercise you can compute the value of H 'FFFF'.

You may well ask, "Is there a justification for hexadecimal?" The answer most definitely is, yes. It is the same reason that octal is of value. You can enter large numbers in a system much faster (fewer key strokes) with octal than you can with binary, and the same is true of hexadecimal by several orders of magnitude. Try expressing the numerical value 14,971 in binary to get the idea of just how time/cost effective the higher valued base systems are.

You can perform basic manipulations with hexadecimal just as you can with any other number family. Take the simple example of adding two numbers such as H '13' and H 'A1':

H '13'
H 'A1'
'B 4'

How do we arrive at this conclusion? The sum of the rightmost column is fairly obvious, 3 plus one = 4. The sum of the next column becomes equally clear if we remember we are really adding 1 plus 10 which equals 11 which equals B in hex notation.

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To prove the answer we get the decimal value of H '13' which is 16 plus 3 or decimal 19. H 'A1' is equal to 10 times 16 plus 1 or 161. The result of the addition is decimal 180. Our answer H 'B4' is the sum of 11 times 16 plus 4, or 176 + 4 which is the same decimal number, 180.

Now let's introduce the element of the "carry" into another simple addition problem, adding H '1A' to H '27':

H '1A'
H '27'
H '41'

How did we arrive at this? The sum of 'A' plus '7' is decimal 17. We deduct the number of sixteens we can get out of this first column addition, and the remainder becomes the right hand figure in the answer. The integral number of sixteens is then added to the next column as a carry. This next column now looks like this . . .

H '1' (the carry)

H '1'
H '2'
H '4'

Checking as before, in the original problem H '1A' equals decimal 26. H '27' equals decimal 39 and the sum of 26 + 39 = 65. Our addition answer H '41' equals 4x16 + 1 = 65. This introduction to hexadecimal should allow you to understand the reference you will bump into as you wander down the I/O trail. ■

*There are many heavenly bodies directly connected with amateur endeavors. If you will locate the zodiac group Aquarius spilling star-studded water across the firmament, you will notice the water falls near the base of the little known constellation of Antennaes. Obviously the grand design is to have Aquarius improve ground conductivity in the region of Antennaes. Also not to be overlooked is the original I/O star, Altair.

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V-V-V LF Generator

-- the lowdown

A major deficiency of the older or less expensive sine wave generator is that its output frequency doesn't go low enough for many vital purposes, the dial typically bottoming out at 20 Hz. A principal reason is the unwieldy values of resistance and capacitance required by the oscillator to tune subaudio frequencies. The instrument described here was designed specifically to complement the workshop sine wave generator by filling in at the low end of the spectrum. It circumvents the tuning problem by providing a number of discrete switch-selected output frequencies.

The frequencies I chose are 1 Hz and 2 to 20 Hz in 2 Hz steps (see Fig. 1). Given different circuit values, however, the instrument is capable of a much wider range, as we will indicate. Maximum output amplitude is 3 volts rms or 8.5 volts peak-to-peak. A pot-and-switch attenuator allows the output level to be set, with a fair degree of precision, to any value within a range of 5 decades. The unit is powered by two 9 volt batteries of any type. Performance does not suffer until either battery potential drops below 6 volts.

How it Works

As shown in the circuit diagram, the sine wave generator employs a common IC, the popular type 741, in a Wien bridge oscillator. This kind of circuit is characterized by a four-element r-c network connected in the feedback path of an amplifier. The four elements are R6 in parallel with the capacitor selected by S2A, and R7 in series with the capacitor selected by S2B. This network is connected in the positive feedback path of IC1, so oscillation occurs at the frequency where zero phase shift occurs. The two selected capacitors are always equal in value, to keep the reactance of the parallel combination the same as the series, so that the voltage-dividing action of the network gives the same amount of feedback at any frequency. The selection of these capacitors is discussed under "Choice of Parts."

The gain of the amplifier, and hence the amount of positive feedback necessary to sustain oscillation, is determined mainly by the setting of output adjustment R3 in the negative feedback path. However, feedback in a sine wave oscillator is very critical; too little and the oscillator quits, too much and it saturates, generating a square instead of a sine wave. Nonlinear elements are usually introduced to deal with this problem. One system uses a lamp or thermistor where we have connected R3. Current sensitive elements such as these, however, introduce perturbations due to thermal inertia. Another method uses a voltage sensitive element like a zener diode, connected in the positive feedback path.

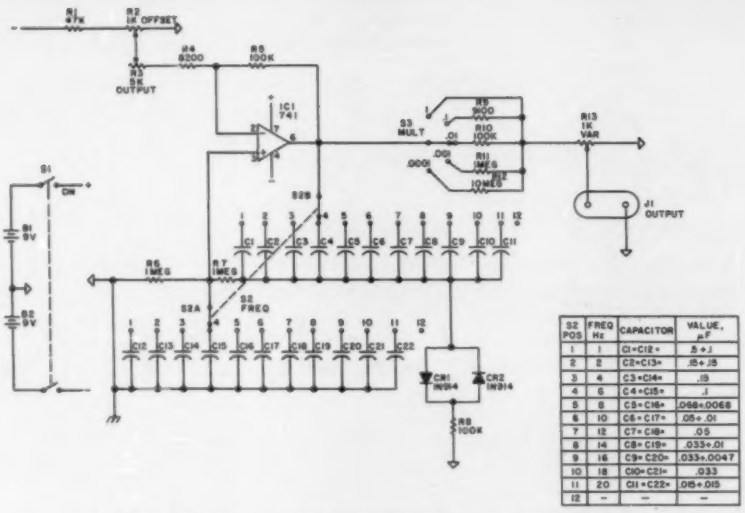
Zener diodes, though not suffering thermal undulations, have a deleterious effect on oscillator waveform, tending to flatten the peaks. So we have introduced a variation of the zener idea; ordinary silicon diodes CR1 and CR2 constitute the required nonlinear load, but waveform distortion is minimized by the mitigating effect of series resistor R8. This scheme yields a good sine wave without making the adjustment of R3 terribly critical.

A small dc offset results from the constraint offered by higher resistance in the positive input of the op amp than in its negative input. Hence offset adjustment R2 is provided to set the average output level of the op amp to

zero, as described later under "Adjustment."

Due to the shunting action of the network R8, CR1, and CR2, the formula normally used to find the frequency of a Wien bridge oscillator does not apply to our instrument. Furthermore, since this is a nonlinear network, frequency depends somewhat on the amplitude of the sine wave appearing across it. As a practical matter, with R3 adjusted to give a signal of 8.5 volts peak-to-peak at pin 6 of IC1, the oscillator frequency is f = 0.6/C, where C is the value selected by S2A or S2B, in uF.

It is important to keep in mind that the setting of R3 does have an effect on frequency. Also, be advised that R2 and R3 interact slightly.



S2 POS	FREQ Hz	CAPACITOR	VALUE, μF
1	1	C1+C12+	.5+.1
2	2	C2+C13+	.18+.18
3	4	C3+C14+	.18
4	6	C4+C15+	.1
5	8	C5+C16+	.068+.0068
6	10	C6+C17+	.05+.01
7	12	C7+C18+	.05
8	14	C8+C19+	.033+.01
9	16	C9+C20+	.033+.0047
10	18	C10+C21+	.033
11	20	C11+C22+	.015+.015
12	–	–	–

Fig. 1. LF sine wave generator, using Wien bridge oscillator.

Choice of Parts

Frequency is determined by the two capacitances selected and by R6, R7 and R8. Precision resistors are recommended for use in these latter three circuit locations to give you the best chance of achieving the same output frequencies as mine. Also, a precision resistor gives better long-term stability than an ordinary carbon composition type.

Likewise, stability is best served by using high quality film capacitors. Ceramics would be a dubious choice due to reports of frequent problems with stability, leakage, temperature sensitivity, tolerance, power factor and just plain open circuits (especially when capacitors of this type are obtained on the surplus market). Electrolytics or other types that polarize should not be considered.

If you want the output amplitude of the generator to be exactly the same for every setting of FREQ switch S2, the two capacitance values selected in each position must be matched exactly. Note that most of the values in the table were obtained by connecting two capacitors in parallel. For example, C1 and C12 are each 0.6 uF, achieved by paralleling 0.5 uF and 0.1 uF. The two 0.5s should be matched and so should the two 0.1s. I used a capacitance bridge for this selection job. Of course, the closer the actual value of the capacitors to the figures given in the table, the more accurate will be the frequency settings.

If you don't have a capacitance bridge, you can match the capacitors in-circuit. Two capacitors are matched if the output level remains the same when they are interchanged. However, this cut-and-try method is tedious and tricky at best. Therefore, to keep the adjustment procedure reasonably short, we will proceed on the assumption that you have somehow managed to match the capacitors or else don't care if the output level varies slightly from one frequency setting to the next.

You may wish to extend the frequency range of your instrument. There is no lower limit, but the upper is dictated by the op amp itself, output amplitude suffering beyond about 5 kHz. Using a high frequency op amp (such as the 741S) will extend the frequency range to about 20 kHz. Also, it helps to connect a small capacitor from pin 2 of the op amp to common; the value is best determined experimentally but 250 pF would be typical.

Position 12 of S2 was left unused to permit the addition of jacks for external capacitors, if test signals outside the present frequency range of the device are required.

Construction

There are no special precautions to be observed in construction. My instrument is built in a 5-1/4" x 3" x 2-1/8" LMB box chassis No. 136. This box is admittedly a bit small to comfortably accommodate all those capacitors, and you would be smart to use a bigger one.

In my unit, the IC and a few other small parts are wired onto a perfboard, which is mounted to the chassis box by a spacer.

The batteries are mounted inside the cover with double stick tape.

Adjustment

If you are using precision resistors for R6, R7 and R8, and have carefully selected the capacitors, the probability is very great that your output frequencies will be right on the money, and all you need for testing and adjustment is a VOM. If you wish to check output frequency, you will of course need suitable test equipment such as an oscilloscope with accurate timebase. To adjust the sine wave generator, proceed as follows:

1. Set offset adjustment R2 to its minimum voltage, or ground, position, MULT switch S3 to the 1 position, VAR control R13 to its maximum output position, and FREQ switch S2 to 20 Hz.

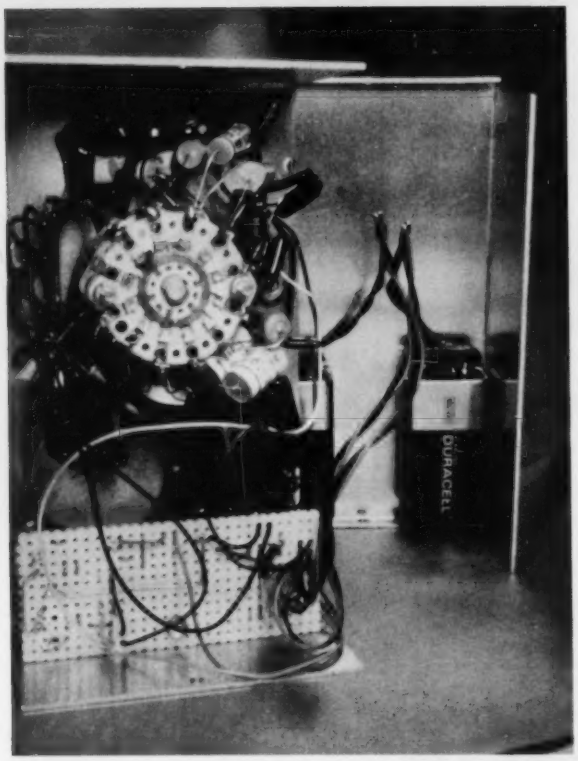
2. Connect a VOM to output terminals J1. Set the VOM to measure ac voltage and adjust R3 to obtain 3 volts rms. (Don't use the "output" feature if your VOM has one, because its coupling capacitor may not be big enough to pass 20 Hz without some attenuation).

3. Set the VOM to measure dc voltage on its lowest range, and adjust R2 to obtain zero volts.

4. Repeat steps 2 and 3 until no further adjustment is necessary.

You may now calibrate the VAR control if desired. I calibrated my instrument in terms of peak-to-peak voltage, but you may prefer to use rms instead. An oscilloscope is more convenient to obtain values in the former units, a VOM in the latter.

If you have access to an oscilloscope, check frequency and amplitude of the sine wave at various switch positions. Variations in amplitude are caused by imperfect matching of the capacitor values. Errors in frequency at some switch positions but not



others means inaccurately selected values.

If all frequencies should prove to be off by about the same percentage and in the same direction, the problem is easily solved by changing the value of R8 as required, to make the output frequencies exactly correspond to the dial markings. Raising or lowering R8 by 20 per cent lowers or raises the frequency by about 8 per cent. However, varying R8 changes feedback, so you should repeat the adjustment procedure each time you try a different value.

There are no special tricks to operating the instrument, but remember that the output is dc coupled and a suitably large capacitor or some other means of dc translation is needed if you wish to drive any conductor on which dc is present.

A small dc offset appearing in the output as the minus battery runs down can be balanced out, if necessary, by touching up offset adjustment R2. ■

Parts List

B1, B2 – 9 volt battery
C1-C22 – Film capacitors (values given in table, see text for discussion of matching)
CR1, CR2 – 1N914 diode
IC1 – Op amp, Fairchild Type FU5B7741393 or equivalent
J1 – Dual binding post, red and black, H H Smith Type 269RB
R1 – 47,000 Ohm, ¼ Watt resistor, 10%
R2 – 1000 Ohm miniature potentiometer, Mallory MTC-13-L1
R3 – 5000 Ohm miniature potentiometer, Mallory MTC-53-L1
R4 – 8200 Ohm, ¼ Watt resistor, 5%
R5, R10 – 100,000 Ohm, ¼ Watt resistor, 5%
R6, R7 – 1 megohm, ¼ Watt precision resistor, 1%
R8 – 100,000 Ohm, ¼ Watt precision resistor, 1%
R9 – 9100 Ohm, ¼ Watt resistor, 5%
R11 – 1 megohm, ¼ Watt resistor, 5%
R12 – 10 megohm, ¼ Watt resistor, 5%
R13 – 1000 Ohm linear potentiometer
S1 – Toggle switch, double pole single throw
S2 – Rotary switch, 2 pole, 12 position
Misc. parts – Battery connectors (2), perfboard, knobs with indices (3), suitable chassis, mounting hardware, etc.

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Shoeing Your HT

- - semi-ideal mobile setup

Get the most out of your HT by building this inexpensive mobile amplifier. I must confess to begin with that this idea was taken from Motorola's "Converta-Com" consoles. I realize that my unit in no way compares with the Motorola unit, which was designed along with their fine HT220, but, not having an overabundance of money and already owning a Wilson 1402SM HT, I decided that mobilizing my present HT was the only way to go.

Like most amateurs, I have accumulated over the years many pieces of treasure (junk); going through this treasure, I came across a CB radio chassis and case which I decided would make a good housing for the unit.

I started by stripping the components from the chassis. When I finished the chassis it was a pretty sad sight, and I thought to myself, "Do you really want to put your beloved HT into this mess?" But I had already spent the time removing the old components, so I proceeded. The face plate had a large hole previously occupied by the speaker. I slid my HT through the hole and it rested on the flat surface of the chassis. I installed two side rails on the chassis and a tension band to the back of the chassis to secure the HT once inserted. I lined these contact surfaces with suede leather to prevent marring the exterior of the HT.

Having completed this step, I installed a terminal strip on the chassis where connections for the external plug of the HT would terminate. I then checked the owner's manual for pin connections on the HT, secured a male plug, heated up the trusty old soldering iron, and started soldering a multi-cable to the plug. Although there were nine pins on the external plug, it was necessary to use only five. The pins and their uses are: pin #1 – + voltage; pin #2 – receive-transmit switch; pin #3 – ground; pin #4 – external

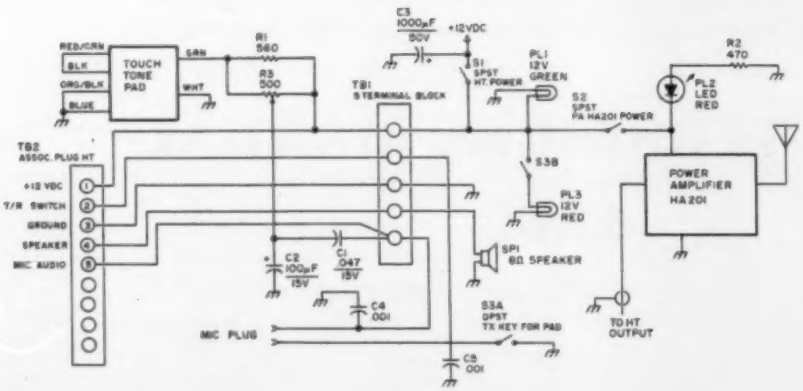

Fig. 1.

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speaker; pin #5 – mike audio. After having soldered the cable to the plug, I routed the cable through a hole drilled in the face plate to the terminal strip previously mounted in the chassis. Terminal connectors were installed and connected to the terminal strip.

I then cut a hole in the face plate, installed a touch-tone pad, and wired it to the terminal strip.

My next step was to install a speaker and connect it to the terminal strip. Having completed this, I then mounted a mike jack to the face plate and routed the shielded cable to the terminal strip.

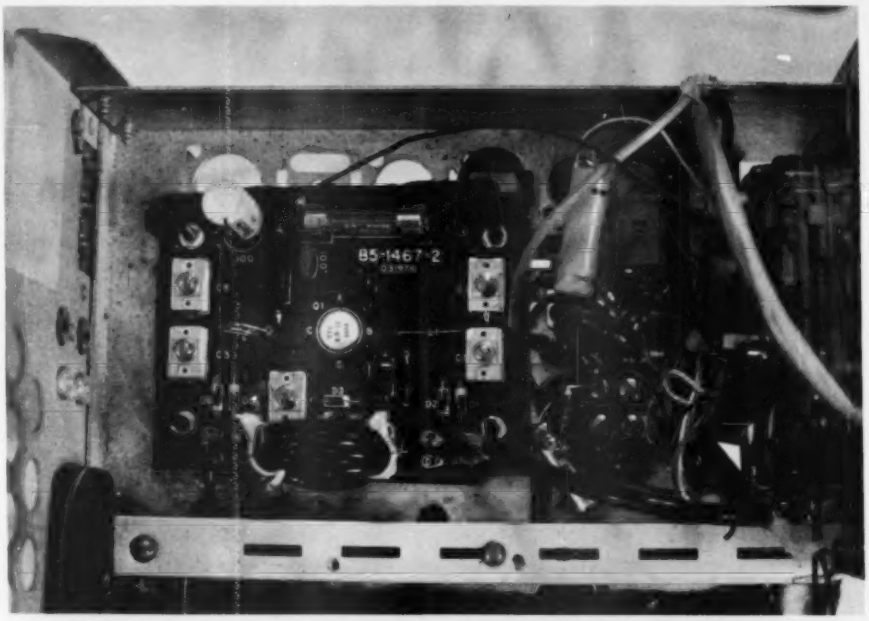
Looking over my labors and noting all the empty space inside the chassis, I said to myself, "Why settle for 2 Watts output?" So I began to consider installing an rf amplifier in the chassis.

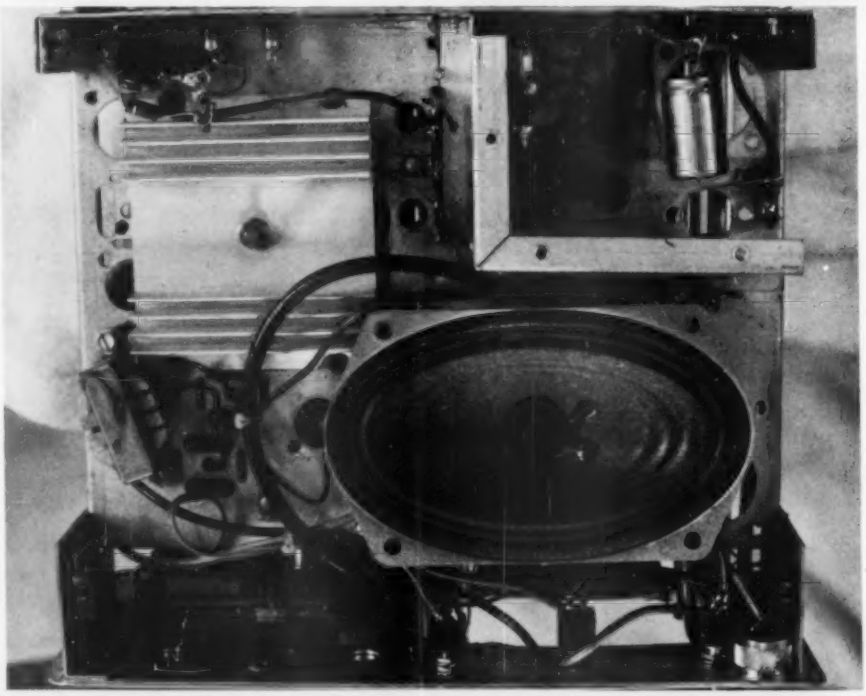
After much inner debate, I decided to purchase the Heathkit HA-201 10 Watt amplifier. The deciding factor in this decision was the reasonable price of the unit.

I hastily made a trip to the local Heathkit Center and purchased the kit. As with most Heathkits, I had no problem with assembly and was finished in a couple of hours. I did have a problem placing the circuit board in the chassis. When I had removed all the old components from the chassis, it was left with many holes. I had decided to discard Heathkit's chassis and mount the circuit board to the CB chassis, but the transistor was left with no heat sink due to one of the large holes. I made a trip to a local electronics store and picked up an aluminum heat sink to install under the chassis, thus providing much better heat dissipation than that provided by the Heathkit chassis.

I connected the coax supplied by Heathkit from the HT to the amplifier and from the amplifier to the SO-239 connector which was spared in the stripping operation; the plus voltage lead was terminated at the terminal strip. Placing the HT in the unit, I carefully checked over my work, not wanting to watch it all go up in smoke. I placed a Bird in-line wattmeter at the output and a dummy load in place. I carefully placed +12.5 volts to terminal #1 and negative to ground, and turned on the power supply. Observing no smoke or loud crackling noises, I turned on the HT, keyed the hand mike, and observed 5 Watts on the meter. Being brilliant enough to realize that the HT only put out 2 Watts, I said to myself, "It's working!" While keeping a close watch on the meter, I tuned the rf amplifier. After I completed the alignment, the Bird wattmeter indicated 12.5 Watts. Listening to a nearby receiver, the transmission was loud and clear, and the touch-tone was adjusted to what appeared to be a proper level.

Upon removing the 50 Ohm dummy load and installing a quarter wave antenna, I easily brought up the local repeater, but I





noticed that the wattmeter had dropped to 7.5 Watts. I realigned the amplifier, thus regaining the lost power. I used the TT pad and had no problem.

Finishing up, I mounted control switches on the face plate and a power plug to the unit. I was now ready to try it in my truck.

With the engine off and the wattmeter in line, the output once again was down to 7.5 Watts. I realigned the amplifier, bringing the power up. Checking reflected power, I discovered that the 5/8 wave antenna showed flat. Upon cranking the engine, I saw that there was no problem with reception – but transmission was another story. Every arc, spark, and whine under the hood was present in the signal. Through a process of elimination, I determined that the noise was entering the mike audio input; this problem was quickly solved with a 100 uF electrolytic capacitor from the wiper of the 50k pot on the pad circuit to ground.

Now, back to the unexplained problem of power loss from the Heathkit rf amplifier. I determined that the output circuit was very sensitive to changes in load, however slight. I decided to install the rf detector circuit supplied by Heathkit for alignment of the amplifier. I connected this circuit to the SO-239 connector inside the chassis (terminated to the female meter pins at the back of the chassis) and, with a Simpson 260 VOM, aligned the amplifier while connected directly to feedline and antenna.

A big advantage to this unit is that in no way does it resemble a Citizens Band radio and, therefore, it is perhaps less likely to be ripped off. The HT itself can be easily removed for safekeeping. I can just see a would-be thief gaping at the large hole where the HT had been. ■

P. Scott Smith WB9JSE
7723 West Bender Ave., Apt. 1
Milwaukee WI 53218

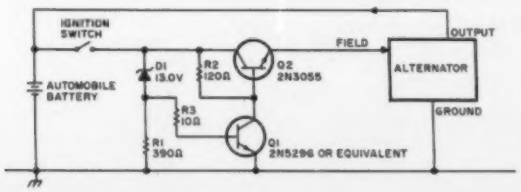
$22 for a Regulator? Never!

-- a simple car voltage regulator

A price of $22 for a new voltage regulator in my automobile gave birth to this simple yet very effective solid state replacement. The circuit should be usable in almost any negative ground system using an alternator.

A few words about the automotive battery charging system will help in understanding the operation of this circuit. An alternator's output voltage, and thus its charging current, is controlled by varying the field current in the alternator. Full voltage on the field winding will give full output from the alternator, and reducing the field voltage will result in reduced output. The output capacity of any alternator is limited by its design, primarily the wire size used. In fact, loading an alternator heavily will rarely damage it, as it will put out just so much current, and beyond that its output voltage will drop, limiting the total power available.

In the usual electromechanical type regulator, a resistor is switched in series with the field winding to reduce the alternator output. When the battery voltage drops due to a heavy load, the resistor is shunted by a pair of contacts on the relay, which is voltage sensitive. Under normal conditions, with the engine running, battery voltage should be approximately 13.6 to 13.8 volts, indicating the battery is receiving a charge.



In order to best understand the electronic circuit, it can be looked at as a switch, either supplying no or full voltage to the field winding. Start with a low battery voltage. Diode D1, a 13.0 volt zener, does not conduct as long as the battery is below 13.0 volts. If D1 is not conducting, no bias is applied to Q1 base, keeping Q1 turned off. If Q1 is off, Q2 is on fully, being biased by R2, 120 Ohms. It then applies full battery voltage to the field winding on the alternator. This of course means the alternator will put out full voltage to the battery, causing it to charge.

Now, as soon as the battery voltage increases to 13 volts, a small amount of bias is applied to Q1 base as the diode begins to conduct. If the battery reaches 13.6 volts, the zener diode will conduct fully, dropping 13.0 volts and leaving .6 volts to bias Q1. When this happens, Q1 turns on fully, reducing the voltage on Q2 base to very close to zero. Q2 turns off, removing all voltage from the field. Now the alternator output is reduced to zero, so the battery receives no charging current.

In actual use, this entire process happens very rapidly, and the constantly changing alternator is in effect smoothed out by the battery. Battery voltage will always be the zener diode voltage plus the drop across the base-emitter junction of Q1, about .6 to .7 volts. Resistor R3 limits the base current to a safe value.

My unit was built on a large heat sink with all parts being supported by the transistor leads. This is not really necessary, as both transistors are operating as switches and consume very little power. The circuit has survived the past winter in my car, and has always kept the battery properly charged, and at a fraction of the cost of a new regulator. It might be a handy circuit to keep in mind the next time you are left with a dead battery due to a faulty regulator, or if you are doing any experimentation with windmill power and surplus auto alternators. ■

Ward Lindsey WA4WOC
1580 S.E. 32nd St.
Gainesville FL 32601

Cash In on the CB

- - installation for fun and profit

In the last two years, the demand for technicians to install and repair Citizens Band radios has skyrocketed. With the expansion to 40 channels expected to increase the number of units in use, it doesn't look like the supply of technicians will catch the demand in the near future. Your ham background may be all you need to turn this shortage into a lucrative part-time venture. With the determination not to offer your services free of charge, you can support your ham habit entirely from working for CBers – at your convenience. Whether you decide to cash in on installations, repair, or both, the business opportunity is there. The rest is up to you.

If you have installed a two meter rig in your own vehicle, you've got the practical experience necessary to start into "installation for hire." If not, you're sure to find neighbors or relatives eager to let you practice until you feel confident that you can successfully complete an installation in profitable time. Two or three will tell you whether you've got the knack for it. After you've done a hundred, you can do it in your sleep.

Complete step-by-step instructions for doing installations are beyond the scope of this article. If you feel you need them, you should consider mowing lawns or shoveling snow to earn extra cash. Mostly, this article is intended to steer you away from the disasters that can befall even the simplest of installations.

The typical CB installation (a dash-mounted unit with a trunk lip antenna) takes a guy who's handy with a wrench about an hour. The going rate to perform such a service in this part of the country is a flat thirty bucks. The tools required are a screwdriver, a small crescent wrench, a soldering iron and a 3/8" drill with bits. A $15 swr bridge completes a professional installation. You can do two on Saturday and still have time left over to mow the lawn, watch the ball game, and work a little DX before supper.

No commercial license is required to do installations, and a classified ad in the local newspaper will net you plenty of part-time business. Have some business cards printed and leave them with the salesmen in the local stores that sell CB equipment. Having someone to refer his customers to for installation is a strong selling point for the CB retailer. Very few places that sell CB equipment do their own installation work. Word-of-mouth advertising may be all you need in more rural areas.

Before you rush out to make your fortune in the installation business, there is one pitfall to consider. Always remember that people who pay someone else to install their CB sets have no knowledge of electronics whatsoever and are liable to blame you for malfunctions or operator error that is not your fault.

Ask your customers a few questions before you agree to do a job at a certain price. What kind of vehicle does he own? What kind of antenna does he want? Where does he want the antenna mounted? A roof-mounted antenna on a station wagon takes a lot longer than one hour. The skill required to do a neat, professional looking job of running the coax is greater, and the risk of doing expensive damage to the vehicle is multiplied. Don't be ashamed to refuse a job for these reasons. If you decide to do it, don't be afraid to charge more for the extra work and risk involved.

You should make certain that the customer understands that alternator whine and ignition noise are the fault of the vehicle, not necessarily the fault of the radio and *absolutely* not the fault of the installation. Usually these noises can be eliminated or reduced to an acceptable level by methods discussed later, but if you can't get it out it's his problem. If you spend an extensive period of time eliminating noise problems, the customer should be required to pay a reasonable fee for this service – above and beyond the cost of the installation.

Be sure that you and the customer are in complete agreement as to the location of all components before you drill any holes. There are a lot of special installation tools on the market, but a hole remover isn't one of them. While you are discussing the location of components with the customer, be as observant as possible of detail. Always be on the alert for snags in the installation itself. When you see a good reason why a particular component should not be put in a particular location, explain why and suggest a location more suitable. This not only makes the job easier for you, but also increases the customer's confidence in your ability, which is an asset you can't afford to be without. Greater love hath no man than an American for his automobile.

Take ten minutes to go over every motion involved in the actual installation. Look closely at what you are going to do before you lift the first tool. This will cut the installation time in half, because you won't have to change your strategy in midstream.

It is probably easiest to run the antenna cable first. This way, when you are ready to run the cable under the front of the carpet, the unit isn't in your way. On a trunk lip or deck-mounted antenna, feeding the cable through the trunk to the back seat is where you are going to cut your hands. Get yourself a broken antenna rod or similar stiff fish wire to do your poking and probing. Once the fish wire is run, tape the coax to it and pull it through. Always try to run the coax under the carpet on the passenger side. It's a real pain working under the steering wheel.

The carpet in all sedans has a split under the front seat. You can pull the cable by hand straight from the back to this split, and then

C&S marketing

introduces out-of-sight CB that's ready for 40 when you are!

$239.95

Hy-Gain 9 (model 2679) sells for $239.95 with Hy-Gain 426 AM/FM/CB antenna. Deduct $20.00 if you don't want antenna.

The following Hy-Gain 23-channel radios can be remanufactured to FCC 40-channel specifications after January 1, 1977 and FCC type acceptance.

681, 682, 2680, 2681, 2682, 2683, 2679, 3084

If you currently own one of these radios, a 40-channel certificate may be obtained from your Hy-Gain dealer.

Now! Get the Hy-Gain CB system that's ready for 40 channels when you are. Our out-of-sight Hy-Gain 9 (Model 2679) citizens two-way transceiver and Hy-Gain 426 AM/FM/CB 40-channel antenna.

The great Hy-Gain 9 transceiver goes out of sight in the trunk or under the seat. All that's visible is the hand-held MSR (microphone, speaker and radio) Control Unit with built-in mic and speaker. Disconnects easily. So you can take it with you. Or store it away. Superb performance includes TVI filter to help prevent TV interference.

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reach from the front to the split and pull the cable through next to the transmission hump. This is much quicker than removing the metal strip that holds the carpet down and running the coax along the side. If the car has electric seats, remove the strip; you will never be able to get your hand under the front seat. The biggest problem in running the cable is placing it too near the clip that holds the back seat down. The cable gets pinched when there is extra weight on the rear seat and you'll have an intermittent radio. You have a tendency to look sideways at a CBer when he tells you the radio won't work when the wife and kids are in the car with him, but the joke is on you when you find the problem.

If the cable comes with one of those solderless PL-259 connectors, take it and heave it as far as you can. When you get good at distance, practice for accuracy. Buy a good connector and solder it on. It's a dollar well spent. The cable that comes from the factory with the connector attached is usually OK, but inspect it before relying upon it. When you check the swr, wiggle it to make sure it isn't intermittent.

The installation of the antenna mount is up to you and the instructions. Follow them and you should encounter no great difficulties. Roof-mounted antennas are easier to install if you remove the dome light and center punch a dent upwards a little behind the light itself. Headliners vary greatly from vehicle to vehicle. The only advice offered is *be careful.* Very few cars have headliners designed so that it is possible to run the cable without showing, and it is really easy to leave wrinkles. The slightest mistake sticks out like a sore thumb. Never pull any more of the headliner loose from the roof than is necessary to pull the fish wire through. When drilling a 3/8" hole in the roof, slip a piece of ½" conduit over the drill bit so that only about ½" of the bit protrudes. This prevents you from drilling through the roof and into the headliner. Don't trust your reflexes to stop in time – it will never happen.

Antennas are easiest to install on pickup trucks. There are three basic types of headliners. One has a double wall steel roof, one has a foam-backed headliner glued to the roof, and the third has a cardboard headliner. When removing the cardboard type headliner to run the coax, take out only half the screws. The headliner will hang out of your way. If you make the mistake of removing the headliner completely, it will take you twenty or thirty minutes to put it back – and you are going to look like a scene out of a Marx Brothers movie fighting to get it back in place. On the other two types, mount the antenna about two inches in from the back edge of the roof. You can then fish the cable over to the sidewall and down. On some trucks you will have to drill a hole in the sidewall to bring the cable out.

Mounting the unit itself will present no problem on dashes that are made of metal. On plastic dashes, you have to use bolts with nuts and lockwashers instead of sheet metal screws. A little forethought and you are home free. On most CBs, the mike hangup bracket bolts right to the unit. The only warning in mounting the unit is to look behind where you plan to drill on the dashboard. Many autos run a power lead in the lip where it is most convenient to drill the holes for the bracket. A hole through this cable creates an unbelievable amount of smoke.

On units that have two power leads (one red and one black), it is sometimes difficult to find a place to secure the ground lead. This is especially true on late model cars where the dash is all plastic. If this is the case, you can cut the ground wire short and fasten it under one of the screws that holds the case on the unit. The unit will be grounded through the antenna, even if bolted to a plastic dash. The hot lead should go through the firewall directly to the battery. You will probably have to use some zip cord to make it long enough. Use butt splices or solder the wires together – don't just twist and tape. Splicing in under the dash or connecting the unit to the fuseblock is OK, but when you are finished and there is considerable alternator whine, you are going to have to run the wire to the battery anyway.

If the customer has purchased a hump mount for his unit, there is one precaution you should take. Never, never drill a hole through the carpet without cutting a plug out of it first. If you do, the pile catches on the bit and it takes about a quarter of a second to put a two foot run in the carpet. Get an ice pick and punch a hole through the carpet and the floorboard. A sheet metal screw will start right in the hole without the need to use a drill at all. Also, make sure the screws you use aren't too long, or they will hit the transmission housing.

Assuming the unit is functioning and there are no great noise problems, you are ready to tune the antenna. Check the swr on channel 1 and check it again on channel 23. If the swr is higher on channel 1, the antenna is too short. If it is higher on channel 23, it is too long. Adjust until it is the same or as near the same as you can get it on both channels and tell the customer it is flat.

The biggest headache in mobile installations is engine and electrical system noise. It ranges from the pop of the firing spark plugs to the grind of electrical windshield wipers. Some cases are for all practical purposes impossible to defeat. Most are at least reducible.

Engine noise is a lot like lightning. It generates rf throughout the spectrum and is picked up by the antenna. It is then detected just like any signal on the band. Since it is an amplitude modulated signal, it gives the CB receiver a fit. Very few noise blankers or noise limiters in CB receivers are effective against this noise, so the cure lies in eliminating or reducing the radiation of this noise from the engine compartment. Grounding straps on the hood, with good metal-to-metal contact to the car frame, is a good place to start. If this isn't effective, take a pocket size AM radio and snoop around under the hood until you find the source of the noise. If you are lucky, it may only be a bad plug wire, but listen around the distributor and ignition coil just the same. Fabricate some sort of metal shield to go around the culprit and ground it good to the car frame. Sometimes a poor connection on the coaxial shield will allow engine noise to run rampant, but this condition will show up when you check the swr. If the customer says he has no engine noise at low speeds, but it is terrible on the highway, check to see that the little ball on the antenna rod has not been removed. Corona discharge is often a source of noise, so remember when you have to trim an antenna rod to trim it from the bottom.

If you have tried everything you know to eliminate the noise and the customer is still not satisfied, tell him the only solution left is to spend about thirty bucks for a noise blanker. There is one on the market, manufactured by TEST, called (appropriately enough) an Ignition Noise Eliminator. It works like the extender circuit in a Motorola. There are four wires to connect: one goes to the ignition coil, one to ground and the other two in series with the speaker leads.

When the coil fires, it opens the speaker. There is plenty of junk on the market for CBers to waste their money on, but this thing really works.

Alternator whine is the next biggest noise problem, but it is far easier to defeat. Running the hot lead directly to the battery will eliminate alternator whine almost every time. If it doesn't, try an LC filter right where the hot lead goes into the radio. If neither of these things work, it's a good bet that there is a ground loop somewhere. Ground the chassis of the radio and the ground lead (if it has one) to the same point on the car body. Check to make sure that the antenna mount is securely grounded. Save buying an expensive alternator filter as a last resort, because it probably isn't going to help anyway.

The smallest number of noise problems comes from accessory motors and defective equipment. The latter refers to bad alternator bearings or a shot water pump. The cure for these is obvious. Fan motors, windshield wiper motors and the like are sometimes the source of irritating noise. The worst offenders in this category seem to be Japanese vehicles. Feedthrough capacitors are the best weapons against these motors. On multi-speed motors, you will need one capacitor for each speed, plus one for the power lead.

At this point, if any noises discussed so far are still in the unit, you'll just have to remind the customer that you warned him this might happen and hope you are the wiser. You are going to find noise problems that you can't beat if you do many installations, but the stubborn cases are few.

Installing CB radios can become a lucrative pastime for any amateur with the attitude and patience required to do a respectable job. ■

John A. Houser K2EE
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Rensselaer NY 12144

Surplus Headset Mod

-- no tanks needed

As supplied, the headset from the WW II Tank Transmitter/Receiver Mark II (Photo 1) was about the most uncomfortable thing one could think of using. (It may have been good bumping around in the tanks.) But it can be easily adapted for ham use, and as it sells on the surplus market for $2.50 up, it's actually a real bargain when adapted.

Photo 2 shows how to adapt it for comfortable usage.

The steps are as follows:

1) Remove (snap out) both springs secured by the web (former) headband. Remove the web strap.

2) Carefully cut 2 cords on each earpiece which secure a rubber protector. Remove the rubber protector and the cords from the 2 terminals on each earpiece. Be careful in removing the nuts as some of the machine screws are not secured inside the headpiece.

3) Remove the steel strap (it snaps off each bracket). Remove the brackets from the earpieces. Break off the outside spring piece from each bracket (this formerly held the neck steel strap to bracket).

4) Braze (preferably) or firmly solder the steel former neckpiece to each of the springs removed from the web.

5) Secure a standard headset cord and attach it to each phone. Reassemble the extensible steel headband and brackets to each earphone, as shown in Photo 2. ■

Photo 1.

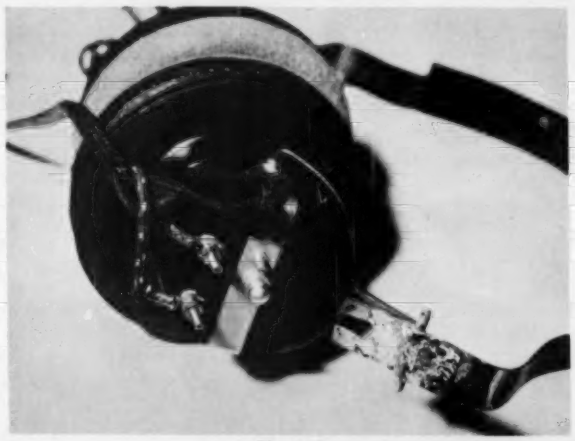

Photo 2.

Steve Ford WB8IMY
1481-A Tabor Avenue
Kettering OH 45420

Am I Really Transmitting?

- - red and green LEDs for the TR-22

Ah, the Drake TR-22! It's an extremely versatile rig at a sensible price. This is a rig that has everything for most FMers. Well, almost everything.

Let's say that you happen to be cruising down a poorly lighted thoroughfare at night and you'd like a little company. Why not call WB8XYZ? You grab the mike and press the switch, but you can't seem to key up the local machine. Is your rig on the blink? Has your super mobile gain goody fallen off the roof? Maybe you've been sitting on the mike for the last few miles and the repeater has timed out. Well, it's anybody's guess because it is just too dark to see if the relative power meter is moving or not. Your next step will probably be to turn on the local AM radio and mutter to yourself about why you don't have any indicator lights on your TR-22.

If you've read this far, you are probably nodding your head and smiling bitterly. Well, cheer up, because a solution is just paragraphs away. Read on!

Installing the LED indicators in the TR-22 is a fairly simple project that can be completed in one evening. The result will be added convenience as well as a smarter look for your rig. There are as many varieties of the LEDs as there are ways of installing them, so, even though my steps in this project will be detailed, it is up to the individual ham to design around his own particular situation.

I started by acquiring some surplus LEDs at the '74 Dayton Hamvention. The conical shaped diodes (3/8 inch long) were picked since they would be easier to work with. These surplus LEDs can be purchased cheaply and are quite sturdy. I was lucky to be able to get them in green as well as red, so it was decided that the green LED would be used as the power indicator and the red LED as the transmit indicator. It would be wise to choose low current LEDs since they will draw less battery power when the rig is portable.

Most LEDs are low voltage devices and will require dropping resistors in series with them. I used 2 volt LEDs and found that a 300 Ohm ½ Watt resistor in series worked best. As mentioned before, however, LEDs differ, so the proper resistor value for your particular choice of diode should be determined by the circuit shown in Fig. 1. Before applying the supply voltage (12 V dc) to the circuit, make certain that the potentiometer is set in the position of maximum resistance and that the diode is *properly polarized* with the supply voltage. (The negative side of the conical LEDs is often marked by a flattened edge on the diode itself.)

The next step is to apply the voltage and slowly decrease the potentiometer resistance until the voltmeter across the diode reads 2 volts (or whatever voltage your LED requires). Now just measure the pot's resistance at that point and let that determine the value of the dropping resistor.

With the resistors out of the way for now, the time has come to get down to the nitty-gritty of the installation. I began by drilling two 3/16 inch diameter holes into the front of the TR-22 (see Fig. 2) through which the tips of the LEDs would protrude. (Hole size will differ with other LEDs.) The internal circuitry was carefully covered with cellophane before drilling to prevent metal shavings from causing electrical chaos. After filing off the rough edges of the holes on the inside of the rig, I touched up the outside with flat black paint where some of the original paint had flaked off during drilling.

I decided to mount and wire the transmit (red) LED first. The dropping resistor was connected to the positive lead of the diode and an insulated wire was routed from the other end of the resistor to a nearby post on the transmitter board labeled *BT*. It is located just behind the crystal deck section that holds the receive crystals, near the 4th channel crystal. It is clearly labeled. The 12 volt source is present here only when the transmitter is keyed. Remember: Always be careful to observe the polarity of the diodes. I ran an insulated lead from the negative side of the diode to the closest ground point. This happened to be the bottom terminal of the squelch pot, that is, the pot terminal closest to you when the bottom of the TR-22 (the transmitter board) is facing up. Of course, any other ground point can be utilized.

The power (green) indicator was mounted near the top of the rig (as shown) near the receiver board. After connecting the dropping resistor

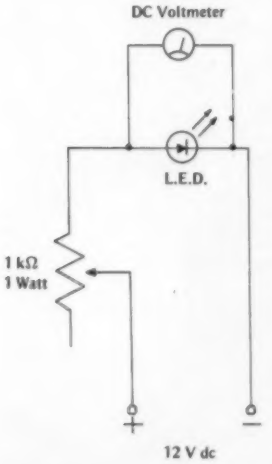

Fig. 1. Circuit for determining the value of the LED dropping resistors.

to the hot side of the diode, I again routed an insulated wire from the other side of the resistor to the bottom side of the TR-22 and found a 12 volt source at one of the switch terminals on the volume pot. I used the terminal closest to the side of the rig (when bottom is facing up) so that the LED would be switched on and off with the transceiver supply voltage. I found a ground point for the diode on the meter terminal that is nearest to the built-in antenna.

After all the wiring was completed, I set the LEDs into the holes. Using a toothpick, I carefully dabbed some quick drying epoxy cement on the *inside* of the rig where the diodes made contact with the edges of the holes.

The end product still draws curious comments at ham gatherings and I often take for granted that it has saved me from a lot of guesswork and maybe from a little potential embarrassment, too! The results were quite gratifying from such a simple project.

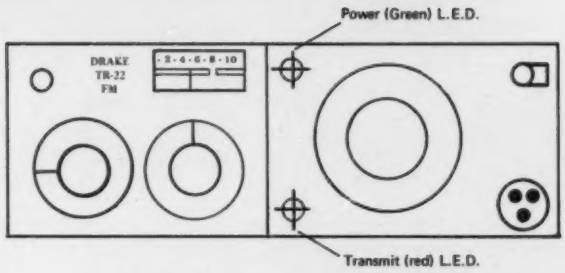

Fig. 2. Location of LEDs on the TR-22.

A special thanks to Chuck Bair WB8NTY for his technical assistance. ■

Dear Gabby

- - exasperation explained

Ken Cole W7IDF
PO Box 3
Vashon WA 98070

You won't remember, but last year I wrote to you about my husband (!) John who was wasting what could have been the best years of our marriage (the children are grown and out in Oregon, making belts and candles) fooling with radios down in the basement and having DX contests, whatever they are. Needless to say, I was never invited. He said they use code and I wouldn't understand. I don't want to understand why they use code — I can guess. Anyway, you didn't exactly sprain a leg helping me, but you printed my letter and John said they read it at his radio club. He was furious, but at least he spoke to me and got my name right.

Now I've got a new problem and this is your last chance, Miss Know-It-All. John met someone named Oscar and now our TV antenna is pointed up in the sky and seems to creep around. He says it's on account of ghosts, but we don't believe in them. And if it's such a hot idea, how come we still have rabbit ears on the TV set and get wiggly pictures when he goes downstairs? You can imagine the queer looks I get from the neighbors when they ask me about our funny TV antenna. That smart-aleck bachelor next door (nearly forty and unmarried!) grinned and said John is probably trying to improve the vertical sink! He works for a television station and has a beard. Can you imagine washing dishes in a vertical sink? Help!

Exasperated

Dear Exasperated:

Your problem is not as uncommon as you may think. Many husbands tend to relax and fade into the basement or the workshop when the children leave. And sometimes when they don't leave. Instead of helping with the housework, they go ape with Oscar, EME, microprocessors (there goes the Christmas money) and other weirdo stuff. Then we have to use some kind of shock therapy to break the spell and re-establish our authority. Melanie, the wife of WA7KYI, came up with an ingenious gambit she calls the Glossary Game, and I recommend it. Just read the left-hand column and challenge John to come up with the matching definitions. The results may surprise you.

Okay, sweetie? After this I think he'll look at you a little differently. Tell him that the rule of the game is that if he missed more than five he has to go back to eleven meters and start over. Try it; the results may surprise you. ■

1. R.F. processor	A receiver
2. Noise blanker	Volume control
3. Broadband	All-girl orchestra
4. Spurious response	I gave at the office
5. Digital readout	Braille
6. Ultra short wave	Mini-ripple
7. Perfect match	Solid gold zippo
8. Gamma match	Gampa
9. Disc cap	Beret
10. Image ratio	Count the mirrors
11. Traffic net	Spaced smokeys
12. Touch pad	Massage parlor
13. Phase distortion	An ugly look
14. Logic probe	A debate
15. Noise bridge	Part of a violin
16. Delta tune	Slap yo' feet on the Mississippi mud
17. Terminal strip	Last act of the floor show
18. Integrated circuit	School bus route

Gene Hinkle WA5KPG
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The Smart Charger

- - auto shutoff and all that

While operating mobile on occasion, I have found it necessary to recharge a run-down battery. This is particularly true when the ham rig was left on inadvertently all night. Contemplating the need for a battery charger, but not wanting to pay the price for a new one, I decided the junk box could be put to good use. I already had a 12.6 V ac, 10 Amp transformer available and I thought a simple rectifier circuit would make a real simple battery charger. However, as long as I was going to the trouble of making a battery charger from scratch, I decided to add another dimension to the typical battery charger circuit design. An automatic turn-off feature was designed into the charger so a maximum charge voltage could be obtained. After the predetermined battery voltage level was reached, the charger circuit would automatically turn itself off. Thus, overvoltage protection would be inherent in this design. Since I had already thought of other applications for the hefty dc power source in the ham shack, I put in an override circuit to the overvoltage sense circuit. By using a Variac at the input of the transformer, an adjustable dc voltage was possible at the output when the manual override was enabled. Fig. 1 shows the basic block diagram of the power supply with the automatic cut-off feature. The trip voltage for the cut-off is adjustable with a variable resistor. Under normal circumstances, the trip point is pre-set with a good, fully-charged battery connected across the output terminals.

Fig. 2 shows the schematic diagram of the battery charger. With the output voltage below the trip point level, transistor Q2 is turned on and the relay RL1 is closed, applying full output voltage to the charger's terminal. As the battery is charging, its voltage increases. When the battery voltage reaches the pre-set level, zener diode D1 conducts, turning on transistor Q2 and the relay. The charger's dc power source is then disconnected from the battery, preventing overcharging. If the battery voltage goes below the threshold voltage by a small amount, the relay will automatically connect across the battery, again charging it. Thus, the charger may be left connected to the battery without fear of overcharging. Resistor R_f is used to provide some hysteresis so the relay does not chatter when the threshold voltage is reached. R_f is chosen for about 0.5 volt hysteresis. A 12 volt lamp is used to show when the charger is charging the battery.

To furnish the power source at all times across the charger's terminals, switch S2 grounds the threshold potentiometer so the output voltage does not have any effect on the operation of the relay.

If the ripple is too great, a full wave bridge rectifier may be substituted for the 15 Amp diode. The meter may be left out if it is not necessary to monitor the charging current from the charger.

This charging technique may also be used to charge nicad batteries. A resistor should be connected in series with the batteries however, to prevent excessive currents during the initial charge process. The resistor should have a value to correspond to the maximum charging current permitted. As the nicad batteries come up to voltage, the charging current will drop accordingly. When the predetermined battery voltage is reached, the current will go to zero as the circuit is automatically disconnected. The batteries will be thus protected from excess currents and destruction.

All of the part values are not critical, and should be

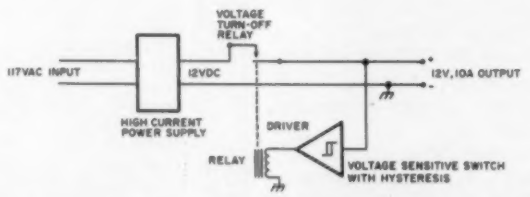
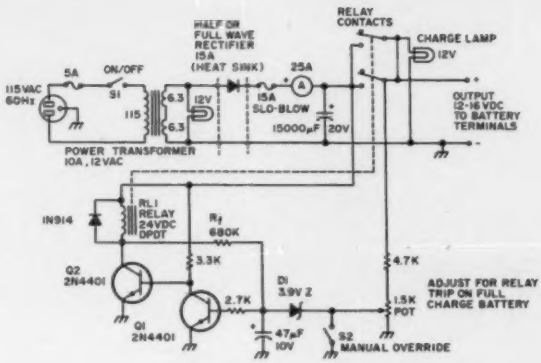


Fig. 1. Block diagram of the battery charger with auto-turn-off feature. Power supply can stand alone for general use. High current power supply is a standard design. Relay interrupts output when the battery voltage reaches the pre-set threshold.

Fig. 2. Schematic diagram of the battery charger and high current power supply with the automatic cut-off feature. A manual override permits use of the power supply by itself for general bench use.

changed accordingly to agree with one's requirements and junk box. Substitutions should be made to keep the cost to a minimum. The transistors should be NPN types with reasonable current gains. Most general purpose types will work. The 3.9 volt zener diode can be replaced with a zener diode in the range of 2 to 6 volts. Its only purpose is to furnish a relatively sharp voltage threshold. The value of the potentiometer may have to be adjusted if the zener voltage is changed drastically. The relay was a 24 volt dc surplus type capable of 15 Amps of current, but other types should work equally well. Most 24 volt relays will work in a 12 volt circuit. ■



Evert Fruitman W7RXV
2808 W. Rancho Drive
Phoenix AZ 85017

Simple Remote Ammeter

-- using a bus-bar shunt

This is really a simplified method for cutting ammeter shunts. There are two things that will not happen. It will not be necessary to do any real deep math, and the meter will not get pinned during the cutting process.

The voltage drop along a piece of wire is proportional to its length and the current through it. If a piece of heavy wire is hooked up as shown in Fig. 1, all of the sport is taken out of making meter shunts.

A power supply, ammeter, resistor, and the bus bar that is about to become a shunt are all connected in series. Long thin flexible leads from the 0-5 mA meter may be used. After all, they are going to carry no more than 5 mA. The negative lead is tied to the power supply and bus minus. The power is turned on and adjusted to give the required current. This is shown on the standard VOM. The plus lead of the 5 mA meter is touched to the bus *near* the minus lead. There should be a small deflection seen on the meter. The lead is then slid along the wire until full scale deflection is obtained. That point on the wire is marked.

If a single range is all that is required, it only remains to solder the leads in place. The resistance change at the point of soldering will be small in comparison to the resistance of the meter. Therefore, the soldering operation will not upset the calibration.

Leave a little more bus at each end than is needed. If the shunt is rather long, then slide insulation over it before the final soldering. The wire may be wound on a convenient coil form in order to make it somewhat more compact.

If a 0-20 Amp range is needed and there aren't more than 2 Amps available, or the shack VOM doesn't have a high Amp range, all is not lost. Set things up as shown above and adjust the power supply for, say, 2 Amps. Then slide the plus lead for 20 divided by 2 or 1/10 of full scale. This will generally prove to be adequate calibration if the standard is reasonably close. Later, when the high current supply is finished and a higher range standard is available, it will take almost no effort to touch up the calibration.

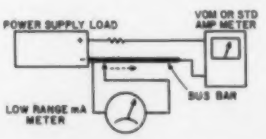


Fig. 1. Setup for shunting meter.

If the shunt turns out to be 10 inches long for 500 mA, then halfway there, or 5 inches up from the cold end, will give a 1000 mA or 1 Amp shunt.

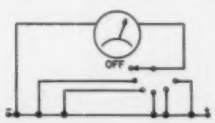


Fig. 2. Multi-range ammeter.

A multi-range ammeter was constructed with this method in less time than it used to take to make a single shunt. Again, since the meter and its leads are carrying only 50 uA or 5 mA (whatever the basic movement is), then a cheap multi-position switch and light hook-up wire will do the job. Number 22 wire may be used for shunts up to about 1 A.

This should get some of those low range mA meters out of the junk box and into circulation. And isn't that like getting a new meter for an old one? Although a 5 mA meter was used in this example, other meters may be used. ■

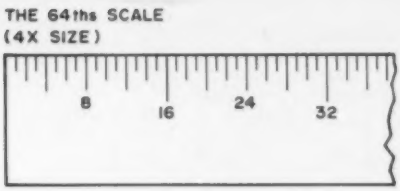


Fig. 1.

Dennis Kehl
3205 Conrad Dr.
Racine WI 53404

Micrometers for Microwaves

-- the art of delicate measurment

Often, during the construction of UHF equipment, the amateur radio operator may be slightly hindered by his unfamiliarity with precision measuring tools. Due to the need for precise measurements of lengths and diameters of components used at UHF frequencies, a brief discussion of some common measuring tools might be appropriate.

The first measuring tool and the most common is the scale, more commonly known as a ruler. A scale may not seem to be a very accurate measuring tool but, with the proper scale, lengths to 5/1000 of an inch can be measured. The best type of scale for general use is made of steel for lasting accuracy, short, between 6 and 12 inches long, so as not to be awkward, relatively narrow, and thin, approximately 1/32 of an inch thick, to help prevent parallax. A precision scale is usually graduated in sixty-fourths, as shown in Fig. 1, or hundredths, as shown in Fig. 2, of an inch. A common precision metric scale is usually graduated in half millimeters. The fine divisions on these scales are not designed to wreck the reader's eyes but are necessary to achieve the highest possible accuracy.

Now, with the proper scale selected, some tips for using it properly are appropriate.

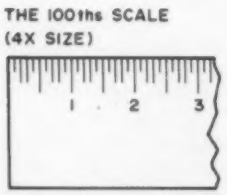


Fig. 2.

Usually a scale's graduations start at the end of the scale; however, if the scale is old, its ends are rounded from use, making it difficult to start at zero. For greatest accuracy, align the first inch mark on the scale with the edge of the stock or starting point. Another tip is not to measure with the scale flat on the work piece, but with it tipped up on its edge to minimize parallax.

The other common measuring tool that will be discussed is the micrometer. A micrometer is a very handy tool to have around when building UHF equipment. All micrometers that read in inches are graduated in thousandths of an inch and have a range starting from 0-1 inch up to and beyond 60 inches. A good micrometer that will last indefinitely can usually be purchased for approximately 20 dollars. Care must be exercised when using a micrometer, because it is a precision measuring tool. It must not be dropped and must be kept clean at all times.

Before using the micrometer, the measuring surfaces of the tool must be cleaned. Do this by lightly closing the micrometer's anvils over a clean piece of paper and sliding it off the paper.

To use the micrometer, first close the tool down gently onto the work to be measured. Then, to read the micrometer, as shown in Fig. 3, first count the number of tenths of an inch on the sleeve, then count the number of quarter tenths of an inch on the sleeve, then count the number of divisions or thousandths of an inch from the zero mark on the thimble to the reference line on the sleeve, and then add these three numbers together to obtain the reading. If a metric micrometer, as shown in Fig. 4, is to be read, the same principle is used. First, the millimeters are read above the reference line on the sleeve, then the half millimeters are read below the reference line on the sleeve, and finally the hundredths of a millimeter are read on the thimble. Add these three numbers together to obtain the reading.

This article was not intended to thoroughly cover all the aspects of precision measuring, but it should serve as a refresher on the basics of measuring with a scale and micrometer, to speed work on projects and to help increase the quality of projects. ■

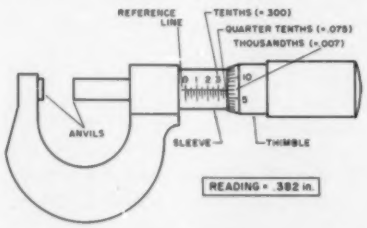


Fig. 3. The micrometer.

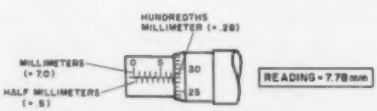


Fig. 4. The metric micrometer.

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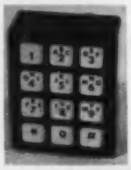
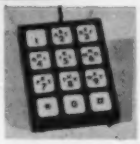


MODEL 200



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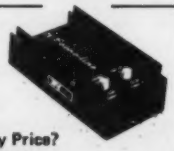

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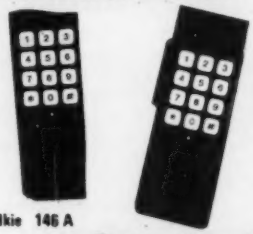

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3 - 5 - 6 - 10 ELEMENTS

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Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Length	6'	12'	20'	24'
Longest E	117"	117"	117"	117"
Turn Rad. ◦	8'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	26 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

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4.5 dB* — 6 dB Omnidirectional GAIN BASE STATION ANTENNAS**

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Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extends. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antenna with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.25'	.35'

8-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 25' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting boome, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.56 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.56 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

8-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 48", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

8-YAGI STACKING KITS VFK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VFK,	complete 4 element stacking kit
A14-8K,	4 element coax harness only
A147-VFK,	complete 11 element stacking kit
A147-8K,	11 element coax harness only
A449-8K,	8 + 11 element coax harness only

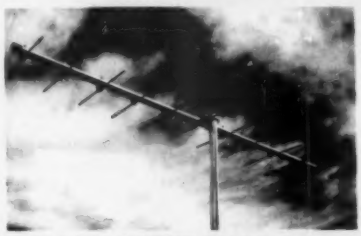
6-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/49"	44"/49"	69"/13"	35",/26"	102",/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	2 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/38	9/20	13.3/38	11/25	13.2/38
½ Power beam	48°	98°	48°	60°	48°
Wind area sq. ft.	1.31	.49	.39	.20	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 120", weight 10 lbs., longest element 60", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS



3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O. D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O. D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	26 dB	26 dB	26 dB
Fwd. Lobe @ ½ pwr. pt.	46°	42°	42°	42°
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

VHF/UHF BEAMS

A50-3	$ 27.50	A144-7	19.95
A50-5	39.50	A144-11	24.95
A50-6	59.50	A430-11	19.95
A50-10	89.50		

AMATEUR FM ANTENNAS

A147-4	$ 15.95	AFM-44D	47.50
A147-11	24.95	AR-2	18.50
A147-20T	47.50	AR-6	24.50
A147-22	69.50	AR-25	21.50
A220-7	18.95	AR-220	18.50
A220-11	22.95	AR-450	18.50
A449-6	15.95	ARX-2	28.50
A449-11	21.95	ARX-2K	11.95
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AFM-24D	49.50	ARX-450	28.50

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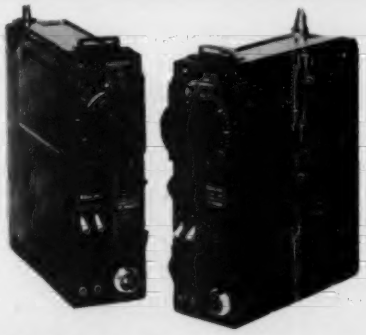

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VXO Tuning • 144.0, 144.2 + 2 More! • INT!
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IC-502
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Switched Dial Lights • Internal Batteries • 800KHz
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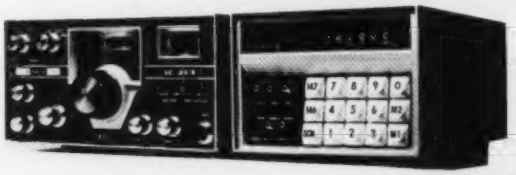

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DV-21 Digital VFO — $299.

IC-21A

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- S.W.R. bridge, built right into the front panel of the IC-21A, is an accurate meter for VHF S.W.R. bridge. An invaluable aid in VHF antenna experiments!
- The IC-21A contains both the 117 V ac and the 13.6 V dc power supplies.

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- The perfect companion for your IC-21 or IC-21A, the DV-21 is a unique digital synthesizer to complete your ICOM 2 meter station. The DV-21 will operate in 10 kHz steps over the entire 2 meter band. It can also scan frequencies being used. Completely separate selection of the transmit and receive is as simple as touching the keys. Release the mic switch, and the receive frequency is displayed. There are also two programmable memories for your favorite simplex-frequencies. You won't believe the features and versatility of the DV-21 until you've tried it.
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This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

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- Front mounted controls and top mounted antenna
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You see IC-215 comes supplied with: 3 popular channels, handheld mic, with protective case, shoulder strap, connectors for external power and speaker, 9 long-life C batteries.

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Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

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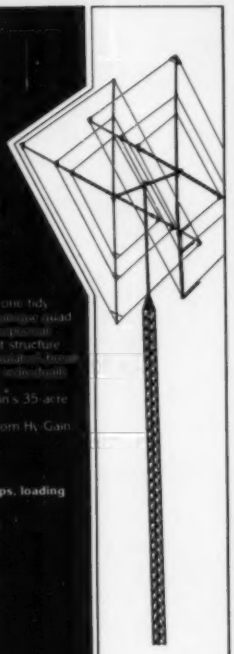

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Hy-Q Traps

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- Super-Strength Aluminum Clad Wire
- Weatherproof Center and End Insulators

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke...will not stretch...withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cycolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

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Strong, lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ⅜" coaxial cable. Shpg. Wt., 0.6 lbs. $5.95

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Rugged, durable, continuously loaded antennas designed for portable applications. Constructed to withstand rough handling. Completely insulated with vinyl coating. Can be bent at all angles without destroying or cracking protective finish. Cannot be accidentally shorted out.

Frequency	136-470 MHz (specify model)
VSWR	2.0 to 1 or less
Loading Coil	Plated wire, silver solder, cad. plated brass base

Model 274 – $9.00 Model 275 – $7.00 Model 269 – $7.00

MODEL 2800 for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs. $49.95

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Order No. 383

BROAD BAND DOUBLET BALUN for 10 thru 80 Meters Model BN-86

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95

Shpg. Wt. 1 lb. Order No. 242

Hy-Gain SINGLE BAND DOUBLET Model HD-4

High performance single band doublet installs horizontally or as inverted V. Takes 500 watts P.E.P. Supplied with cutting instructions for 10, 15, 20, 40 or 80 meter operation. Complete with miniature center and end insulators, 50' RG58/U and necessary copper clad stranded steel wire. Shpg. Wt. 3.3 lbs.

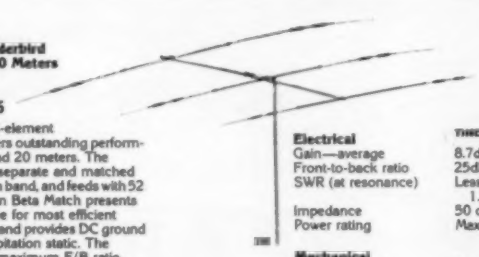
Order No. 214

END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95

Order No. 156

Super 3-Element Thunderbird for 10, 15 and 20 Meters Model TH3Mk3



Price: $119.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	TH6DXX	TH3Mk3
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6DXX

Price: $239.95

The Super Thunderbird TH6DXX offers the ultimate in tribander performance and mechanical reliability for 10, 15 and 20 meters. Separate Hy-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and readjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. **Price: $120.00**

MATCHING NETWORKS

MN-4
200 watts
Price: $110.00

MN-2000
2000 watts PEP
Price: $220.00

General: ● **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power ● **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 ● Covers ham bands 80 thru 10 meters ● **Switches in or out** with front panel switch ● **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14⅛"D (36.5 cm).
● **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) ● **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.

RF WATTMETERS

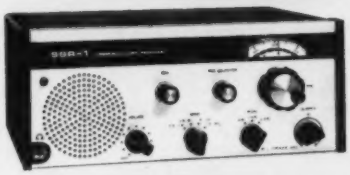
W-4 1.8-54 MHz **Price: $ 72.00**
WV-4 20-200 MHz **Price: $ 84.00**

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3½"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	±(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE

- **Synthesized • General Coverage**
- **Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands**
- **Excellent Performance**



SSR-1 COMMUNICATIONS RECEIVER

PRELIMINARY SPECIFICATIONS: ● **Coverage:** 500 kHz to 30 MHz ● **Frequency** can be read accurately to better than 5 kHz ● **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM ● **Selectable sidebands** ● **Built-in power supply:** 117/234 VAC ± 20% ● **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) ● **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.

The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.

Price: $350.00

GENERAL: ● **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges ● **Solid State VFO** with 1 kHz dial divisions ● **Modes** SSB Upper and Lower, CW and AM ● **Built-in Sidetone** and automatic T/R switching on CW ● **30 tubes and semi-conductors** ● **Dimensions:** 5½"H, 10¾"W, 14⅜" D (14.0 x 27.3 x 36.5 cm), **Wt.:** 16 lbs. (7.3 kg).

TRANSMIT: ● **VOX or PTT** on SSB or AM ● **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts ● **Adjustable pi-network.**

RECEIVE: ● **Sensitivity** better than ½ μV for 10 dB S/N ● **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. ● **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression ● **Diode Detector** for AM reception. **Price: $599.00**

34-PNB Plug-in Noise Blanker	100.00
FF-1 Crystal Control Unit	46.95
MMK-3 Mobile Mount	7.00
RV-4C Remote VFO	120.00

TR-4C SIDEBAND TRANSCEIVER

POWER SUPPLIES	
AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

2 Meter FM Portable Transceiver

Model TR-33C

Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel.

Linear Amplifier L-4B

L-4B Linear Amplifier 895.00
● **2000 Watts PEP-SSB** ● **Class B Grounded-Grid — two 3-500Z Tubes** ● **Broad Band Tuned-Input** ● **RF Negative Feedback** ● **Transmitting AGC** ● **Directional Wattmeter** ● **Two Tautband Suspension Meters** ● **L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs.** ● **Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.**

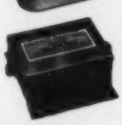
POWER SUPPLIES	
AC 4 Power Supply	$120.00
DC 4 Power Supply	135.00

Drake TVI Filters

High Pass Filters for TV Sets

provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Model No. 1603
Drake TV-300-HP
For 300 ohm twin lead
Price: $ 7.95



Model No. 1610
Drake TV-75-HP
For 75 ohm TV coaxial cable; TV type connectors installed
Price: $ 9.95

LOW PASS FILTERS FOR TRANSMITTERS have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

Model No. 1608 **Drake TV-3300-LP**

1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems.
Price: $19.95

Model No. 1609 **Drake TV-5200-LP**

200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP.
Price: $19.95

Model No. 1605 **Drake TV-42-LP**

is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input.
Price: $10.95

TUFTS RADIO

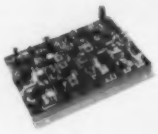
TUFTS RADIO CATALOG

vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS

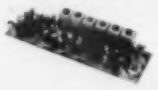
RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	59.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T.	same as above – factory wired and tested	114.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T	same as above – factory wired and tested	114.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50



RF28 Kit	10 meter RF front end 10.7 MHz output	12.50
RF50 Kit	6 meter RF front end 10.7 MHz output	12.50
RF144D Kit	2 meter RF front end 10.7 MHz output	17.50
RF220D Kit	220 MHz RF front end 10.7 MHz output	17.50
RF432 Kit	432 MHz RF front end 10.7 MHz output	27.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TRANSMITTERS

TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T.	same as above – factory wired and tested	49.95
TX220B Kit	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T.	same as above – factory wired and tested	49.95



TX432B Kit.	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above - factory wired and tested	59.95
TX150 Kit	300 milliwatt, complete 2 meter transmitter, less crystal and mike	19.95

POWER AMPLIFIERS

PA2501H Kit	2 meter power amp – kit 1 w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95

PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95

POWER SUPPLIES

PS15C Kit	15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95

O.V.P.	adds over voltage protection to your power supplies, 15 VDC max	9.95
PS3A Kit	12 volt – power supply regulator card with fold back current limiting	8.95
PS3012	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/foldback current limiting and over voltage protection, wired and tested	239.95

REPEATERS

RPT28 Kit	repeater – 10 meter	TBA
RPT28	repeater – 10 meter, wired & tested	TBA
RPT50 Kit	repeater – 6 meter	TBA
RPT50	repeater – 6 meter, wired & tested	TBA
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95

RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
DPLX144	2 meter, 600 KHz spaced duplexer, wired and tuned to frequency	399.95
DPLX220	220 MHz duplexer, wired and tuned to frequency	399.95

TRANSCEIVERS

TRX 144 Kit	case and all components to build 15 watt 10 channel scanning 2 meter transceiver (less mike and crystals)	219.95
TRX 220 Kit	same as above except for 220 MHz	219.95
TRX 432 Kit	same as above except 10 watt and 432MHz	254.95

SYNTHESIZERS

SYN II Kit	2 meter synthesizer, transmit offsets programmable from 100 KHz - 10 MHz, (Mars offsets with optional adapters)	169.95
SYN II	same as above, wired and tested	239.95

WALKIE TALKIES

HT 144B Kit.	2 meter, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
NICAD	battery charger	5.95
Rubber Duck	2 meter, with male BNC connector	8.95

OTHER PRODUCTS BY VHF ENGINEERING

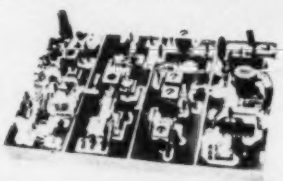
CD1 Kit	10 channel receive xtal deck w/ diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD-3 Kit	UHF version of CD-1 deck, needed for 432 multi-channel operations	12.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority.	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
Microphone	2,000 ohm dynamic mike with P.T.T. and coil cord	9.95

Build a 2 meter or 220 MHz Transceiver

10 Channel Scanning . . . 15 Watt

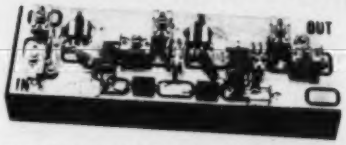
You can put it all together for only $219.95

RX144C or RX220C Receiver Kit



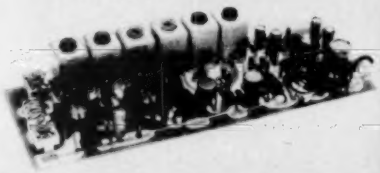
SENSITIVITY .3uV for 20db quieting. SQUELCH THRESHOLD .2uV. AUDIO OUTPUT 2 watts. STABILITY better than −.002. IMAGE REJECTION 60db. SPURIOUS REJECTION greater than 60db. IF REJECTION 80db. FIRST IF 10.7 Mhz. SECOND IF 455 Khz. BANDWIDTH 15 Khz at 3db, 60 Khz at 30db (40 Khz with optional 4 pole filter). CRYSTAL 45 Mhz parallel at 20pf (HC/25U holder).

PA144/15 - 15 Watt Power Amplifier

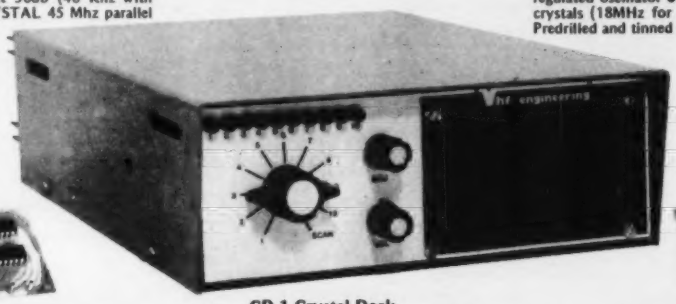


POWER GAIN; 12 db nominal, INPUT POWER; 2 watts max., INPUT VOLTAGE; 12 to 14 volts DC negative ground, INPUT CURRENT; 4 amps max., STANDBY CURRENT; virtually insignificant, INSERTION LOSS; less than 1 db on receive, DUTY CYCLE; 50% or less. Consists of drilled glass PC Board, heat sink and all components.

TX 144B or TX220B Transmitter Kit



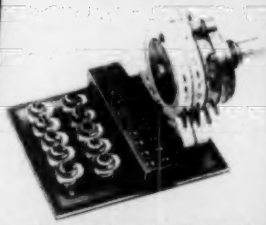
A one watt exciter using four RF transistors, two diodes, and one integrated circuit. The RF transistors are operating well below their ratings allowing long keying periods without damage. • Nominal output 1½ watts • Deviation adjusted to 10KHz • IC audio with clipping and active filter • All spurious outputs down 30db or more • Temperature compensation crystal trimmer • Zener regulated oscillator • Uses readily available 12 or 18 MHz crystals (18MHz for 220) • All tuning coils prewound • Predrilled and tinned G-10 Circuit board



SC-3 Scanner

Capable of scanning up to 10 channels. Scan delay allows both sides of a conversation to be monitored without the scan starting each time the carrier drops. The priority feature allows the user to program the scanner to return to his favorite channel whenever it is active.

CD-2 Crystal Deck



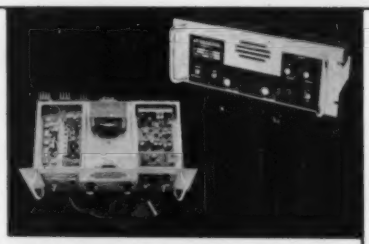
Designed to provide multi-channel operation for the TX-series transmitters. It features an extra set of contacts that may be wired to the CD-1 crystal deck for 10 channel transceive. The extra contacts may also be used to switch L.E.D. indicators. The switch has 11 positions.

CD-1 Crystal Deck

A ten channel receiver crystal deck which utilizes diode switching to select the crystal position required.

Complete with cabinet, speaker, hardware, L.E.D.'s, all accessories and full assembly instructions.

(Crystals and microphone not included.)



IF YOU ARE ON 144, 220 OR 432 AND HAVE WORKED A REPEATER...

It was probably this one.

The RPT 144B, RPT 220B and RPT 432 are self-contained – all solid state machines. Conservatively rated, high quality components, assures EXCELLENT RELIABILITY. Careful consideration has been given to both interfacing and control flexibility.

RPT 144B or RPT 220B Kit	$485.96
RPT 432B Kit	515.95
RPT 144B or RPT 220B factory wired and tested	695.95
RPT 432B factory wired and tested	795.95

WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 KHz to 10 MHz. No additional components are necessary!

Kit . . . . . $169.95 Wired and tested $239.95

TUFTS RADIO CATALOG TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIO

ARGONAUT #509

AMPLIFIER #405

TEN-TEC

ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter, SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 ..... $329.00
Linear Amplifier, Model 405 ..... 159.00
Power Supply, Model 251 (Will power both units) 79.00
Power Supply, Model 210 (Will power Argonaut only) 27.50

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, pre-selectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:

Model 240 One-Sixty Converter....$ 97.00
Model 244 Digital Readout 197.00
Model 245 CW Filter ..... $ 25.00
Model 249 Noise Blanker 29.00
Model 252G Power Supply 99.00
Model 262G Power Supply/VOX.. 129.00

TEN-TEC

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. **PRICE $67.50**

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. **PRICE $38.50**

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. **PRICE $25.00**

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. **PRICE $15.00**

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortlessly. The iambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

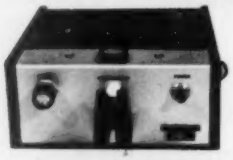
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

PRICE $110.00

SPECIFICATIONS

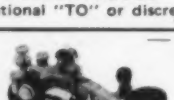
Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms
Power Source: 117VAC, 50-60 Hz, 6-14 VDC
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2⅛" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50A

Nye Viking



Model 310-001: Standard Key, nickel plated hardware, no switch — $6.65.

Model 310-003: Standard Key, nickel plated hardware, with switch — $8.25.

Model 320-001: Standard Heavy Duty Key with nickel plated hardware, no switch — $8.20.

Model 320-003: Same as -001 except with switch — $9.35.

322-001

Code Practice Set with Key — $18.50.

SSK-1: Chrome plated — $29.95; Black Wrinkle Finish — $23.95.

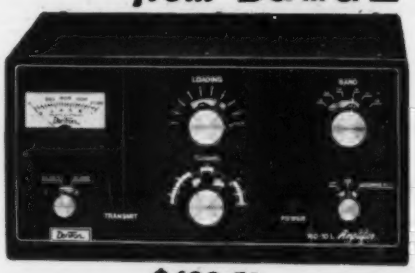
- Fully VSWR & reverse voltage protected
- No tuning required across band
- Switchable Class C or AB operation
- Built-in TR switching, w/increased delay for SSB
- Fully compatible with all 1-15W FM/SSB/AM/CW rigs
- All solid-state and microstrip construction

Mobile Amplifiers With Versatility

SCI **SPECIALTY COMMUNICATIONS SYSTEMS, INC.**

FREQUENCY MHz	MODEL	INPUT POWER NOM.W	OUTPUT POWER NOM.W	OPERATING CURRENT @13.6VDC	SIZE CM HXWXL	RETAIL PRICE
220-225	1.3M10-60L	10	60	7	7.1X10.2X16.5	159.95
144-148	2M10-70L	10	70	8	7.1X10.2X16.5	139.95

SUPER AMP from DenTron



$499.50

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI shielding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4 - 811 A's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all at $499.50.

NOW AVAILABLE WITH 572 B's FOR **$574.50**

DenTron

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50

Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

DenTron

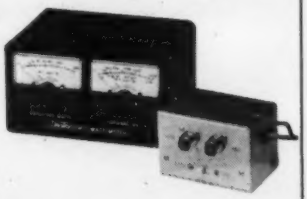
The 80-10 Skymatcher

Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

$59.50

Read forward and reflected watts at the same time



Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

DenTron

The Sky Openers

SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

Also 80 m resonator for top mounting on SKYMASTER.

$29.50

SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds.. Handles full legal power limit.

$79.50

EX-1

The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50

ALL BAND DOUBLET

This All Band Doublet or Inverted Type Antenna covers 160 thru 10 meters. Has total length of 139 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 400 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

DenTron

TUFTS RADIO CATALOG TUFTS RADIO

For all you hams with little cars ...

We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9¼" wide x 9¼" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

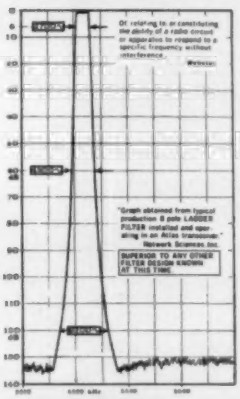
200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.


Graph obtained from typical production 8 pole LADDER FILTER installed and operating in an Atlas transceiver.
Network Sciences Inc.
SUPERIOR TO ANY OTHER FILTER DESIGN KNOWN AT THIS TIME!

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
ACCESSORIES:	
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	80.00
Digital Dial DD-6B	239.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

mounts - leads - accessories

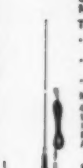
STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL 88LT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. **$28.75**

MODEL 88L-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. **$26.95**



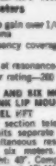
SUPER GAIN MOBILES

Two Meters — **88T -144**

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

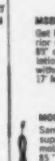
TWO AND SIX METERS—TRUNK LIP MOUNT — **CQ -144**
MODEL HFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259. **$21.45**

VHF/UHF ANTENNA—ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U **$10.15**



MODEL CGT-144
Get big signal performance, superior receiving capability with this 8½" collinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259 **$39.95**

MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. **$26.75**



VHF/UHF ANTENNA—TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. **$15.95**

HUSTLER "BUCK-BUSTER"

MODEL BF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. Mount or cable not included. **$12.75**

HEAVY DUTY BUMPER MOUNT FITS ANY SHAPE BUMPER
MODEL BMH
New design is rugged for supporting Hustler antenna with standard ⅜"-24 base. Kit includes Model SSM-2 ball mount and strap from stainless steel. **$9.95**

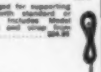
DELUXE MOBILE MOUNTS

For medium weight, light weight antennas with ⅜"—24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connector attached. **$12.95**

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connector attached. **$14.95**

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. **$7.50**



MODEL MM-1
Cowl mount installs in 2" hole. Includes 360° swivel ball and 30-239 connectors. **$ 8.45**

MODEL TBM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. **$7.50**

MODEL C-32
Ball mount complete with mounting hardware **$3.75**

HUSTLER

RESONATOR SPRING—STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. **$ 3.95**

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 360° adjustable ball mount easily supports any antenna weighing up to 5 pounds. Includes cyclolac base, steel back-up plate and mounting hardware. **$13.95**

QUICK DISCONNECT—100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other. **$11.75**

FEED LINE MODEL L-16-240
Get known performance, maximum shielding for minimum noise pick-up in this MIL SPEC 96 % shield RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver **$ 1.45**

MODEL GG-144A — Deluxe, Two-Meter Coilmeter for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ½ wave lower section, ½ wave phasing, ½ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. 50-239 coax connector **$62.95**

HUSTLER RESONATORS

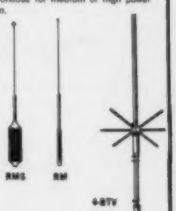
All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS— Power Rating: 400 watts SSB

Model	Band	Price
Res-10	10 meters	$10.75
Res-15	15 meters	$11.75
Res-20	20 meters	$12.75
Res-40	40 meters	$13.75
Res-75	75 meters	$14.75
Res-80	80 meters	$14.75

SUPER HUSTLER RESONATORS— Power Rating: Legal Limit SSB Supers have dual band-width

Model	Band	Price
Res-10-S	10 meters	$13.95
Res-15-S	15 meters	$15.95
Res-20-S	20 meters	$19.75
Res-40-S	40 meters	$23.50
Res-75-S	75 meters	$29.95
Res-80-S	80 meters	$29.95



Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.5 to 1 or better at band edges.
- Hustler exclusive trap covers "Sprite" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 9" **MODEL 4-BTV** Weight: 15 lbs. **$78.95**

For 6 - 10 - 15 - 20 - 40 - 75 - 80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. **$15.95**

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. **$15.95**

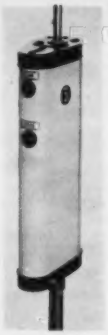
why waste watts?

SWR-1 guards against power loss for $21.95

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation



DELUXE 742 TRI-BAND MOBILE ANTENNA
- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna $79.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA
- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna $114.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

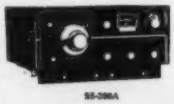
WM2000 in-Line Wattmeter With Muscle. Scales to 2000 watts. New flat response directional coupler for maximum accuracy. $49.95

WM3000 Peak-reading Wattmeter. Reads RMS power then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $66.95

WM1500 High-Accuracy in-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales. 2 to 30 MHz. Forward and reflected power. Use it for trouble-shooting, too. $84.95

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

Hams the world over value amateur radio products from Swan Electronics. Among the most respected of these are the unique single-sideband rigs with that "special something" extra -- like those illustrated here.



SWAN SS-300A Transceiver. Fully solid-state, unique broadband tuning on all five bands, and infinite VSWR protection. Maintains up to 300 watts P.E.P. input on any frequency selected. $799.95

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. $849.95

MARK II

CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet *de novo*, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. $349.95

1200 X

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details or, if you prefer, write:

SWAN® ELECTRONICS

NORTH SHORE
RF TECHNOLOGY

DUPLEXER & CAVITY KITS...

Now available for you fully assembled and tuned!

- UPGRADE YOUR REPEATER WITH A RF TECHNOLOGY DUPLEXER.
- ALL DUPLEXERS AND CAVITIES ARE TEMPERATURE COMPENSATED WITH INVAR® AND MEET ALL COMMERCIAL STANDARDS
- ONLY TOP QUALITY MATERIALS GO INTO OUR PRODUCTS.
- BOTH KITS & ASSEMBLED DUPLEXERS AND CAVITIES ARE AVAILABLE TO YOU AT A SAVINGS TO YOU.

Mod. 62-3...6 cav., 2 mtr., insertion loss 0.6 db with isolation 100 db typical; pwr. 350 w. Kit $349 ea.-Assembled $439.

Mod. 4220-3...4 cav. 220 MHz insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kit $249 ea. - Assembled $329.

Mod. 4440-3...4 cav. 440 MHz, insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kits $249 ea. - Assembled $329.

Mod. 30 Cavity Kits: 2 mtr. $65 ea., 220 MHz $65 ea., 440 MHz $65 ea.,; 6 mtr. $115 ea. Add $15 for Assembled Kit.

Also available: 6 mtr., 4 cav. Kit $399-Assembled $499, 2 mtr. 4 cav. Kit $249-Assembled $329, 440 MHz TV Repeater Duplexer

Only hand tools are necessary to assemble Kits!

Send your order to: Distributor: **TUFTS RADIO**, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280.

(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S.-C.O.D. orders require $50 deposit. —Mass. residents add 5% sales tax.)

TUFTS RADIO CATALOG TUFTS RADIO

THE BIG SIGNAL "W2AU" BALUN $12.95

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

THE PROVEN BALUN

1. HANDLES FULL 1 KW PEP AND THEN SOME. Broad-Banded 3 to 40 Mc.
2. HELPS TVI PROBLEMS By Reducing Coax Line Radiation
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BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1-1 matches 50 or 75 ohm unbalanced coax load to 50 or 75 ohm balanced load. 4-1 model matches 50 or 75 ohm unbalanced coax load to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big signal W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrester and hang up hook.

We'll GUARANTEE no other balun, at any price, has all these features

Now...more than ever--- the TEMPO line means solid value

Tempo VHF/ONE

the "ONE" you've been waiting for

No need to wait any longer — this is it! Whether you are already on 2-meter and want someting better or you're just thinking of getting into it, the VHF/ONE is the way to go.

• Full 2-meter band coverage (144 to 148 MHz for transmit and receive. • Full phase lock synthesized (PLL) so no channel crystals are required. • Compact and lightweight — 9.5" long x 7" wide x 2.25" high. Weight — About 4.5 lbs. • Provisions for an accessory SSB adaptor. • 5-digit LED receive frequency display. • 5 KHz frequency selection for FM operation. • Automatic repeater split — selectable up or down for normal or reverse operation. • Microphone, power cord and mounting bracket included. • Two built-in programmable channels. • All solid state. • 10 watts output. • Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF. • 800 Selectable receive frequencies. • Accessory 9-pin socket. • $495.00

TEMPO SSB/ONE SSB adapter for the Tempo VHF/One • Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Now Standard built-in SLIT and VXO for full frequency coverage. • $225.00.

YAESU

FT 301	160M-10M Transceiver — 200 WPEP	$769
FP 301 DIG	160M-10M Transceiver — 200 WPEP	935
FP 301	AC Power Supply	125
FP 301 CID	AC P.S. w/Clock and CW ID	199
FRG-7	General Cov. Synthesized Receiver	299
QTR-24	Yaesu World Clock	30
FT-101-E 160-10M	XCVR W/Processor	749
FT-101EE 160-10M	XCVR W/O Processor	659
FT-101EX 160-10M	XCVR W/O Processor AC Only, Less Mike	599
FL-2100B	Linear Amplifier	399
FTV-650B	6M Transverter	189
FTV-250	2M Transverter	219
FV-101B	External VFO	99
SP-101B	Speaker	19
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	19
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	89
XF-30C	600 Hz CW Filter	45
XF-32A	8 Pole SSB Filter for FT-101	49
FR-101S SOLID STATE	160-2M/SW RCVR	489
FR 101 DIG SOLID STATE	160-2M/SW RCVR	629

Accessories:		
FC-6	6M Converter	30
FC-2	2M Converter	40
FM-1	FM Detector	20
-	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	45
XF-30C	600 Hz CW Filter	45
XF-30D	FM Filter	49
SP-101B	Speaker	19
FL-101 SOLID STATE TRANSMITTER	160-10M	545
Accessories:		
RFP-101	RF Speech Processor	89
MONITOR/TEST EQUIPMENT		
YC-355D	200 MHz Counter	229
YO-100	Monitor Scope	199
YP-150	Dummy Load/Watt Meter	74
YC-601	Digital Readout (101/401 series)	179
VHF FM & SSB TRANSCEIVERS		
FT-224	24CH, 2M FM	249
FT-620B	6M AM/CW/SSB	449
FT-221	2M AM/FM/CW/SSB	629
Accessories:		
MMB-4	Mobile Mount (FT-620B, FT-221)	19

FT- 101E TRANSCEIVER

Now You Can Receive The Weak Signals With The

ALL NEW

AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Advanced solid-state circuitry.
- Simple to install.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

MODEL PT-2

$69.95

HAM RADIO / MOBILE COMMUNICATIONS

THOMSON-CSF
NPC
ELECTRONICS

MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13CB4	$41.95
102	$24.95	104R	$49.95
612	$27.95	108R	$79.95
107	$28.95	108RM	$99.95
12CB4	$29.95	109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous, 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

ALSO! Available as 13 HM 4 with built-in loudspeaker.

	TYPICAL	MAXIMUM
Output Voltage	13.5 ±.5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 103R

NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MODEL 109R

NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4¾" (H) x 7½" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 5½" (W) x 6½" (D). Shipping Weight: 6 lbs.

MODEL 102

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

Functions silently in converting 115 volts AC to 12-volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MARINE & RV

MODEL 12-115

NPC 12-115 Solid State Inverter. 200 W. Parallel Connection for Higher Power up to 350 W.

Converts 12 volts DC to 115 volts AC @ 60 Hz output; 200 watts continuous operation with peak power up to 240 watts. All silicon semiconductors assure high reliability at excessive ambient temperatures. The output voltage is a square wave. The inverter is not recommended where high transients are not tolerable.

The 12-115 allows you to have AC house current in your boat, car, truck, camper, house trailer, or houseboat. Will operate small household appliances, T.V., hand tools, electric shaver, AC radios, and lights within power rating. Built-in overload protection.

Case: 4½" (H) x 7½" (W) x 5½" (D). Shipping Weight: 7 lbs.

	12 VDC 1N	14 VDC 1N
Output Voltage (No Load)	115 V RMS	130 V RMS
Output Voltage (Full Load)	100 V RMS	115 V RMS
Frequency (No Load)	58 Hz	66 Hz
Frequency (Full Load)	54 Hz	62 Hz
Power Continuous	200W	
Power Peak	240W	
Parallel Connection	350W	

All Values Are Typical

MODEL 612

Model 612 Power Converter

NPC 612 converts 6 volt negative ground or 12 volt positive ground electrical systems to 12 volt negative ground operation. Provides full 3 amp continuous power. The inexpensive solution for installing car radios, stereo and cassette tape players, in vehicles with 6 volt negative ground or 12 volt positive ground systems.

Case: 2⅝" (H) x 3" (W) x 5" (D). Shipping Weight: 1 lb.

TUFTS RADIO CATALOG TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIO

B&W BARKER & WILLIAMSON

model 372 CLIPREAMP

Model 372 – $27.50

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

• specifications

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 25 millivolts
Voltage Gain	10 dB
Output Level	50 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connectors	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 – $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

• specifications

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	6.015 Ampere, 48 to 130 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 300 2W and model 300W

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

Model 300 2W with *Compreamp* – $125.00

Model 300 1W without *Compreamp* – $85.00

• specifications

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic)
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	5-1/8" x 3-1/8" x 3"
Shipping Weight	3-1/2 lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connectors	Phono

BARKER & WILLIAMSON, INC.

Model 359 – $37.50

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the *Compreamp* between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

• specifications

Input Impedance	100,000 ohms
Input Level	5 millivolts to 25 millivolts
Voltage Gain	10 dB
Output Level	50 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	9-1/2 oz.
Connectors	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB. Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

Crosstalk (measured at 30 MHz) is -45 dB between adjacent outlets and -60 dB between alternate outlets.

Models are available for desk, wall, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted; axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.

Model 560A

Model 560

Model 560G

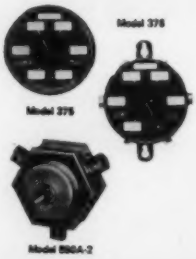
Model 561A

Model 562

Model 566

COAXIAL SWITCH SELECTOR CHART

Model	PRICE	Outputs	Connector Placement	Mounting: Panel	Mounting: Wall	Mounting: Desk	Automatic Grounding	Dial Plate	Remarks
375	18.95	6	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
550A	14.00	5	Radial	x	x			DP-5	
550A-2	12.50	2	Radial	x	x			DP-2	
561A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
560	17.95	5	Axial	x				DP-5	
560G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
562	16.50	2	Axial	x				DP-2	
566	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.



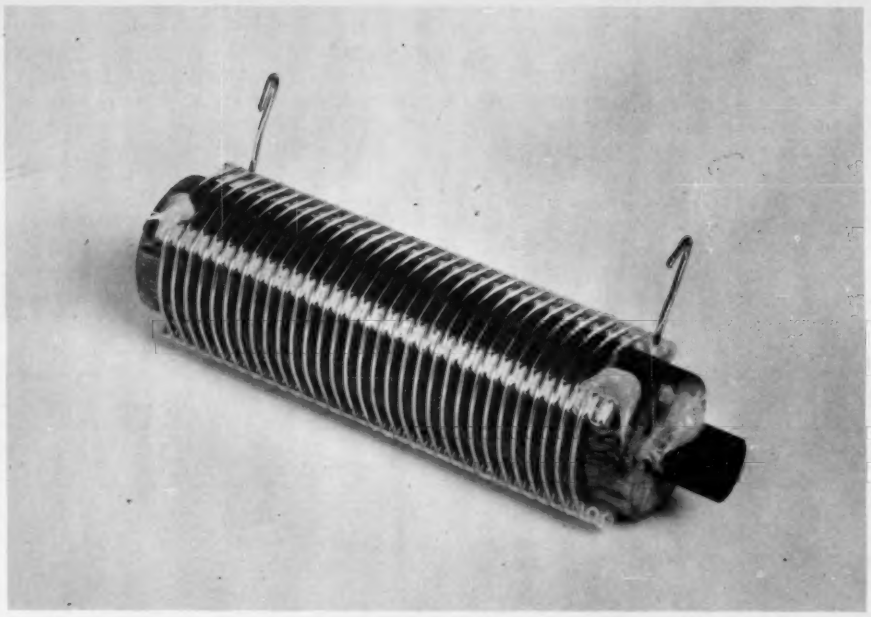


Fig. 1. B & W coil with adjustable permeable tuning slug.

Alfred F. Stahler W6AGX
5521 Big Oak Dr.
San Jose CA 95129

Tuning Those Big Antenna Coils

-- permeability

Recent articles have prompted me to experiment with various antenna configurations. My QTH is restricted in size, so my attention has been directed to physically-shortened antennas. Since a shortened antenna presents a capacitive reactance, an equivalent inductive reactance is required to achieve resonance. These inductors are usually large, to minimize I^2R losses, and, if resonant, have high rf potentials. The standard design solution is to use an air-wound coil (B & W, etc.) and to tune to the desired inductance or resonant frequency, either by trial and error pruning or by shunting with a transmitting type variable capacitor.

This solution is fine, but transmitting variables are rare and expensive and operation during a rainstorm is, at best, unpredictable. One alternate solution is to shunt the inductor with a capacitor made of a length of coaxial cable which yields 15-30 pF per foot, withstands high rf voltage, and can easily be made immune to weather. The problem with this technique is that tuning is

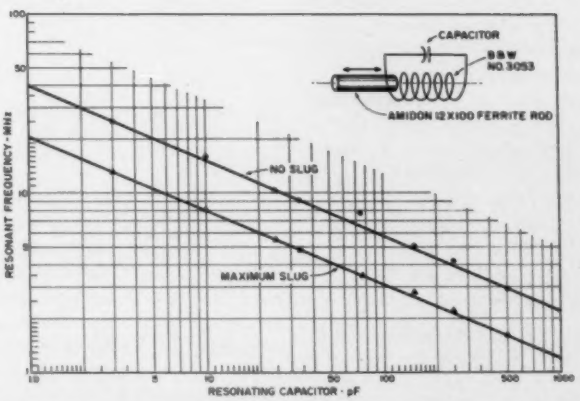


Fig. 2. Comparison of resonant frequencies, with and without permeable slug.

achieved by snipping length from the coax — and in finding resonance one *always* snips too much. Frequency change requires repetition of the capacitance building and snipping process.

Another way to vary the inductance of a coil is to vary the permeability of the space inside the coil; it's a standard tuning method for low level i-f and rf signals. Although variable tuned coils are not commercially available for large, high power inductors, they can be readily made.

Fig. 1 shows a photograph of a variable permeability tuned inductor that was made for a multiband trap dipole. The inductor is a B & W No. 3053 that has an inductance of 12.5 uH. The permeable slug is an Amidon MV-125, 12 x 100 mm ferrite rod ($1.25). The supporting material is a 1-1/8" diameter closet pole with a 1/2" diameter hole drilled through. Once tuned, by sliding the ferrite rod in or out of the hole in the wood, the rod is held in place with a dab of silicone rubber sealer. For retuning, this seal can be broken, the rod readjusted and then resealed.

Fig. 2 shows a curve of the measured inductance variation possible with this ferrite rod and coil combination. Note that over the frequency range tested the ratio of maximum to minimum frequency is essentially constant, indicating that the permeability of the ferrite does not change over this range (it probably decreases at higher frequencies).

I have used this construction technique on several antenna projects for traps, loading coils and for a high power, plate tank circuit. The Q of the coils remains very high and there is negligible loss in the ferrite, even at high power levels. If the wooden ferrite rod guide is boiled in wax or replaced by plastic, the unit will be impervious to weather. ■

Casey Pustelnik W2OSW
1133 Center Rd.
Buffalo NY 14224

Richard Haungs W2UJR
11315 Cary Rd.
Alden NY 14004

The 2m Mod Squad Tackles the Weatherradio

-- and wins!

The Realistic Weatherradio (Cat #12-162) is available from Radio Shack stores for a low price, and can be quite easily converted to two meter FM.

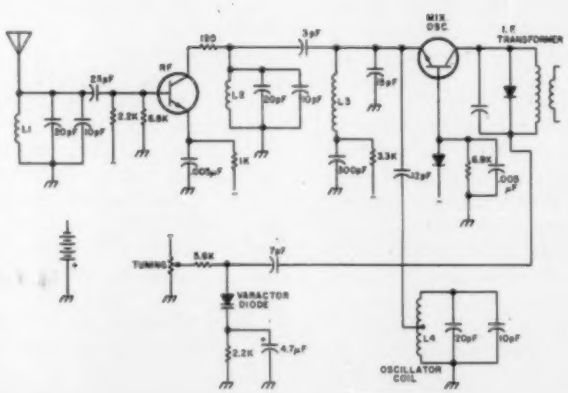
The receiver uses an rf stage and a combination mixer/oscillator. It has positive ground, and either nine or twelve volts may be used, with better sensitivity from 12.

Remove the back cover, battery, and two Phillips screws. Remove the antenna, hold the board at the rear near the speaker hole, and lift up and out. There are two slotted tabs at the front of the case near the thumbwheel controls; the cement on these breaks easily while removing the board.

View the printed circuit side and solder a 10 pF capacitor across L1, L2, and L4. The radio is supplied with a complete schematic which may be helpful. Any good 10 pF capacitors should work as long as they fit with short leads, preferably less than a quarter inch. Either a ceramic or small mica should do. L1 is the tuned rf stage input coil, L2 the rf stage output, and L4 is the oscillator coil. The latter requires the most care in adjustment.

Remove the beeswax from the coils and replace the board into the case. Compress the coils to increase their inductance.

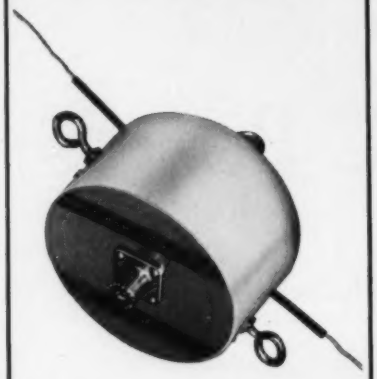
The circuit tunes with a varactor diode. Set the tuning pot to midpoint and compress the coils. You should expect to hear aircraft images. When properly adjusted, the tuning should cover approximately 2 MHz, from 146 to 148 MHz. Adjust L1 and L2 for maximum sensitivity after the oscillator has been set. ■



Reprinted from *The Link*, Bulletin of the Buffalo Amateur Radio Repeater Association, Inc.

5 KW PEP INPUT

WITH THIS NEW BALUN



On all bands 160 to 10 meters.

Runs cool as a cucumber at its CCS rating of 2 KW (Continuous output power through the balun at matched load).
4" dia. Wt. 24 oz. $32.50 PPD.

AND FOR FULL LEGAL POWER

the time tested Model 1K balun is still available. Rated at 1 KW CCS (3 KW PEP input).
2¼" dia. Wt. 9 oz. $16.95 PPD.

ONLY PALOMAR BALUNS HAVE ALL THESE FEATURES

- Toroidal core for highest efficiency.
- Teflon insulated wire to prevent arc-over. OK for tuned feeders.
- Stainless steel eyebolts take antenna tension. Won't rust, won't pull apart.
- Epoxy filled case. Absolutely waterproof.
- Lightning protection built-in.
- Wideband 1.7 to 30 MHz.
- Hang-up hook provided.
- Now available in either 1:1 or 4:1 ratio. 1:1 ratio matches 50 or 75 ohm coax to 50 or 75 ohm balanced load (dipoles and inverted Vees). 4:1 ratio matches 50 or 75 ohm coax to 200 to 300 ohm balanced load.

Free descriptive brochure on request.
Order direct.
Model 2K $32.50 Model 1K $16.95
Center insulator without balun $7.95
Postpaid U.S. & Canada.
Specify ratio 1:1 or 4:1
California residents add 6% tax.
Send check or money order to:

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BOX 455, ESCONDIDO, CA 92025
Phone: (714) 747-3343

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6 METER 440 MHz

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12 Channels
15 Watts
$229.00 Amateur Net

Positive performance at a practical price makes our HR-2B tops on 2 meters. Individual trimmer capacitors give bull's-eye accuracy for working repeaters or point-to-point. The .35μV sensitivity and Hi/Lo power switch insure your hearing and being heard . . . clearly and reliably . . . the Regency way.

...AND THE

HR-440 — **UHF—The Ultimate in FM**

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10 Watts
$349.00 Amateur Net

440 is fresh . . . it's new . . . and with our HR 440 you can use UHF without using-up your budget. So, pioneer some new ground! Put a compact HR 440 under your dash or at your desk. It's the best way to usher yourself into UHF.

1976 Regency ELECTRONICS, INC. 7707 Records Street
Indianapolis, Indiana 46226

Norbert Adsit
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Design Your Own PC Boards

-- the styrofoam solution

Whether you are an old hand at the design of original PC boards, or you are about to embark upon your first masterpiece of copper and phenolic, the method of PC board design and construction described here will show you how to go from schematic diagram to etched board with a minimum of headaches.

You don't have to be a genius to design PC boards; all it takes is a little time, logic and common sense. In this article I'll try to show how to cut down on the time it takes to design PC boards and make it easier to visualize the routing of foil connections between components.

If you've got a schematic of that great project you've been drooling over for months, but have balked at the idea of making PC boards for it, welcome to the club. A schematic diagram is one thing, but turning that mass of criss-cross connections on paper into a PC board with winding foil patterns is another.

Have no fear ... after reading this article, you will be a veritable master of PC board design. A few easy to get household items will turn you into a seasoned veteran in the war against point-to-point wiring. Put away your vectorboard and take up your copper laminate and etching solution!

With the method usually used for PC board construction, four main steps are used.

1. Layout and design work on paper.
2. Transfer of paper design to a suitable template.
3. Application of resist to the board in conjunction with the template.
4. Etching the board.

Using the method described here, the first two steps are combined, the third is eliminated and the fourth is carried out in the normal manner.

The biggest problem I had was the design layout of components and the routing of the foil connections between them. One day while trying to create a layout for a 10/15 meter preamp, I noticed a vase of artificial flowers. The ends of the flowers were stuck in a piece of styrofoam sitting at the bottom of the vase to hold them upright and in place. In my frustration of trying to design the preamp layout I mumbled to myself, "I wish I could just stick components on the board like that" .... grumble, grumble ... one nanosecond later lights started flashing around my head and sirens began to wail. "EUREKA!" I shouted, "I HAVE IT!"

Thundering my way up the stairs, past the frightened and cowering dog, I ran into my room and dug out a small piece of styrofoam. I cradled it carefully in my hands and placed it reverently on my work table, for it was the salvation of my patience and sanity.

After thanking the gods for my redemption from mental anguish and after banging my head three times on the floor in the general direction of Mecca, I began to perfect a method for simple and inexpensive PC board design and construction.

The idea was this: Why spend hours measuring the distance between component leads, drawing diagrams and layouts on paper, carefully cutting out templates and then applying etch-resist when there is an easier way?

All you need to make a PC board of any complexity and of any size are the following easy to get items:

1. One piece of styrofoam.
2. One roll of wide masking tape.
3. A few felt tip pens.
4. One used razor blade.

The styrofoam can be of any size but a piece about 6" by 12" can be used for all your projects. The felt pens must be able to write on masking tape and should be of different widths.

If you have all the items mentioned, you are ready to design your PC board layout.

The first step is to take the PC board you are planning to use and place it on top of the styrofoam. Mark around the edges of the board with a felt tip pen so you have an outline of the board on the styrofoam.

Next take the masking tape and put it right on top of the styrofoam to fill in the outline of the board completely. Now stick the leads of all your major components through the tape and into the foam in the positions you want them to be on the board. This will hold them in place and now you can find convenient locations for your capacitors, resistors, etc.

With all the components sitting there in front of you just as they would be on the actual PC board, draw the foil connection patterns with your felt tip pens from component to component as you wish them to be on the actual PC board. Make sure you draw the foil connections the exact width you want them to be on the actual PC board; this is important because it eliminates making a template, as we'll see later.

With this method you can even make those fancy little round foil lands with the hole in the center that professional PC board designers use. Just whirl your felt pen around

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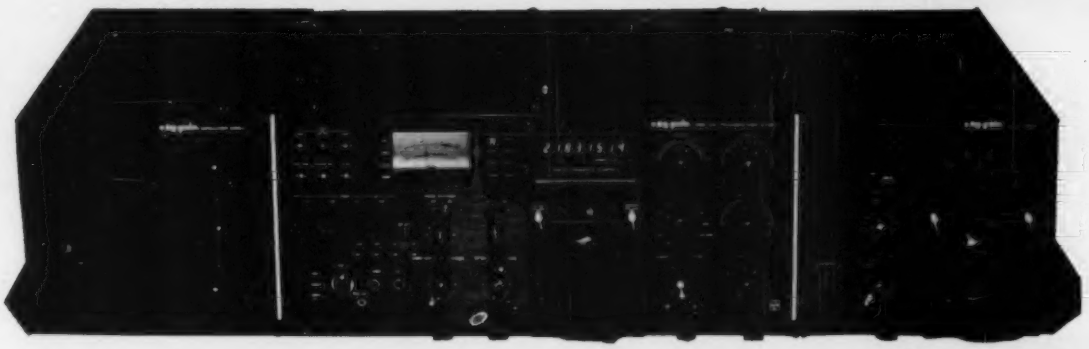

If you are PLANNING TO PURCHASE A NEW TRANSCEIVER, why not GET THE BEST? You should give serious consideration to the new Hy-Gain 3750 Transceiver. With it you can expect superior performance that will surpass the demands of even the most experienced amateur.

The advantages of the new 3750 are many. For starters, more operating frequencies to choose from means more operating fun for the serious radio amateur. With 160 meters fast becoming the favorite of more operators each day, the addition of this band to your shack can only add to your enjoyment of your favorite hobby. Not only more frequencies, but also the greater accuracy of the digital readout make operating the 3750 a real pleasure. With readout to 100 Hz and WWV receive for calibration, you always know exactly where you are. As an added bonus, there is also a memory circuit which will allow you to return to an interesting spot on the band without writing down the frequency. With the optional 3855 VFO you can split TX/RX frequencies for operating DX. The 3855 also has provision for adding up to seven crystal controlled channels.

The 3750 is a pleasure to operate, but it is a dream to listen to. You will never again be annoyed by the roar of a cooling fan. The three tubes are cooled by a fan that is not only whisper quiet, but is also standard equipment. And, you can forget about image and spurious response problems thanks to the narrow band SSB crystal filter in the first i-f. Intermodulation and cross modulation performance are enhanced through the use of dual-gate MOS FETs at all critical rf amplifier and mixer stages. To help cut down the strength of the OM using the California kW, a handy rf attenuator is included. For CW operators, the selectivity is -6 dB @ 400 Hz and -66 dB @ 1.8 kHz.

The same high standard of performance is found in the Transmitter section! Average power output is kept at a high level through the use of an audio compression circuit and automatic level control. The microphone compression circuit gives 20 dB of audio compression and the ALC provides an additional 20 dB to prevent "flat topping" and transmitted adjacent channel splatter. To help reduce the QRN from the neighbors over the subject of TVI, a low pass filter is included in the output state. Speaking of the output stage, it uses two specially developed S-2002 tubes for high peak power output with maximum plate dissipation characteristics. The VFO section of the 3750 delivers an exceptionally stable signal. Drift is less than 500 Hz from turn-on to 10 minutes and less than 100 Hz after a 30 minute warm-up.

Other features include a noise blanker, VOX, and side-tone circuits. All stages have been by-passed and tightly sealed to improve performance and reduce internally generated "birdies" to the minimum possible.

The advanced features of the HY-GAIN 3750 make it quiet a bargain at only $1895.00. For more information, or to place an order, call TOLL FREE 800-251-6771. In Tennessee, call 800-262-6706. Master Charge and BankAmericard are welcome.

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the component lead where it meets the tape. This creates a circle around the lead and leaves a portion in the center that is unmarked which you can use as a guide for your drill bit when you drill the holes in the board. If you wish, you may make extra wide patterns for the common or ground connection on the board, or extra wide bus bar connections simply by using a felt pen with a wider tip.

If you goof someplace in the process of making the foil patterns on the tape, either remove the tape and parts from the foam and put down fresh tape exactly as you did earlier or remove the parts from the tape and then use a damp cloth to wipe off the ink from the tape and start over.

Once you have finished your layout on the foam and the foil patterns on the tape are as you wish them to be, remove all the parts you had put into the foam and carefully peel off the masking tape. Now place this strip of tape on the foil side of your PC board. If some small pieces of styrofoam stick to the tape when you peel it off, just use your fingernail or razor blade to remove them.

Now use the razor blade to cut away all portions of the tape which are *not* colored. These portions will be etched away when you put the board in the etching solution. The tape that is left on the board is your foil pattern. This tape will function the same as the etch-resist coating you normally would use.

Remember, there are no templates to make. Just cut away the portions of the tape you wish to be etched. Simple, isn't it?

If everything has gone according to schedule, you have before your very eyes the semi-finished product of your labors. All that remains to be done is to put the board in the etching solution and drill the holes for the components in the usual manner.

As I am sure you will realize, this method of design and construction has some very appealing points in its favor:

Inexpensive

There is no need to spend hard-earned money on etch-resist or preformed stick-on lands and connections.

Easy

The layout of components and connections is right in front of you to better visualize exactly how foil connections *should* be made.

Flexible

This method can be used for all your projects no matter how complex or simple they may be. If you decide to modify or delete any portions of your circuit, the changes can be made more quickly and easily using this method than the normal design and construction method.

Availability of Parts

Every piece of material needed should be lying around your house someplace. If you find you don't have a needed item and you must buy it, it can be found at a drug store, hobby shop or department store for a cheap price. Perhaps you don't have any styrofoam — well, try digging through the boxes and crates lying around outside in the back of any drug store or department store. The foam is used as a packing filler and shock absorber for goods during shipment. If you work it right, the cash outlay for all the things needed will be exactly zero.

After reading this article you've got *no* excuse to moan and complain about the supposed complexity and cost of making PC boards. So go and dig out your favorite schematic and get to work! ■

Looking *West*

from page 13

John: "That's unfortunate. We've been able to pretty much stem that in my area. In fact, I don't think we have any bananas on any of our repeaters at the present time. We have had some pretty good cases and in one in particular they were able to break up a whole ring. We got the local police in on it; the guy's basement was loaded with all kinds of land mobiles, CBs, amateur and everything else. But the amateurs have pretty much done the investigatory work and have been very successful at it. This story that I heard at dinner tonight, about the Happy Fliers, now there's a real contribution that amateurs are making to technology, so maybe the solution lies right within the amateur community." (Note: The Happy Fliers, a group of flying amateurs, have developed some rather interesting DF equipment and techniques for its use. More on this in future LW.)

"Big Jim" Davis WBØSQP/6 of KHJ radio listens intently to John's program.

We could go on for pages and pages, but as usual we are well past the normal length of this column. I sincerely hope though that through our coverage these past two months, you all have gained a bit of insight into John, his ideas, and his feelings about the service he administers. There is no doubt in my mind, after getting a chance to meet him and hear first hand what he has to say, that he not only genuinely loves amateur radio, but also has a heck of a lot of respect for each of us within the amateur service. He trusts us, trusts in our integrity as individuals to abide by the rules and regulations and to use that special inner respect that seems to be the intangible aspect of bearing an amateur callsign to influence others properly in that same direction. Above all, he feels, as I do, that your individual and collective obligation to be "thinking forward-looking amateurs" never ends; looking toward the ftuture and planning for it is just as important an obligation for you and me as properly maintaining and operating our stations.

In the end, it comes down to this: If we as amateurs sincerely want fewer regulations, then we must each be prepared to assume the burden of responsibility that this entails. We must each work toward being model citizens within the amateur community and provide, on an organized level, a constant flow of ongoing feedback to the Commission and John so that he can thereby know exactly what's happening where, how well things are going, and what can be done to improve things. One suggestion I might make is to put John on your radio club newsletter mailing list, as this is a vital source of local level information. Another is to always offer alternative ideas when commenting on pending dockets. Saying you do not like something is all well and good; but from where in heaven are John and his associates within the Amateur and Citizens Division supposed to find the proper answer unless it comes from you? For indeed, it is you who are the true future of amateur radio. It's a responsibility that goes far beyond that piece of paper you proudly exhibit on the wall. Your license is more than just a badge of pride, it's a badge of responsibility!

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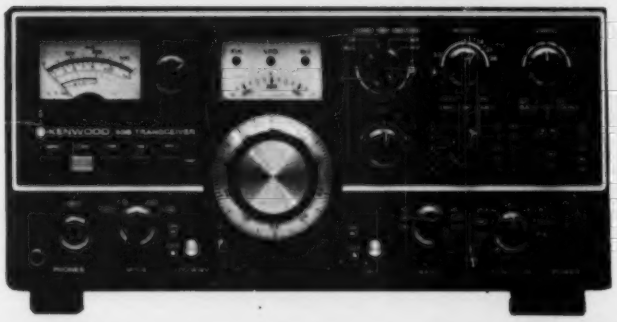
TS-820 Specifications

FREQUENCY RANGE: 1.8-29.7 MHz
(160 - 10 meters)
MODES: USB, LSB, CW, FSK
INPUT POWER: 200W PEP on SSB
160 W DC on CW
100 W DC on FSK
ANTENNA IMPEDANCE: 50-75 ohms, unbalanced
CARRIER SUPPRESSION: Better than 40 dB
SIDEBAND SUPPRESSION: Better than 50 dB
SPURIOUS RADIATION: Greater than -60 dB
(Harmonics more than -40 dB)
RECEIVER SENSITIVITY: Better than 0.25uV
RECEIVER SELECTIVITY:
SSB 2.4 kHz (-6 dB)
4.4 kHz (-60 dB)
CW* 0.5 kHz (-6 dB)
1.8 kHz (-60 dB)
*(with optional CW filter installed)
IMAGE RATIO: 160-15 meters: Better than 60 dB
10 meters: Better than 50 dB
IF REJECTION: Better than 80 dB
POWER REQUIREMENTS: 120/220 VAC,
50/60 Hz, 13.8 VDC (with optional
DS-1A DC-DC converter)
POWER CONSUMPTION: Transmit: 280 Watts
Receive: 25 Watts (heaters off)
DIMENSIONS: 13-1/8" W x 6" H
x 13-3/16" D
WEIGHT: 35.2 lbs (16 kg)

Kenwood's TS-520 has *sold itself* to thousands of amateurs the world over.

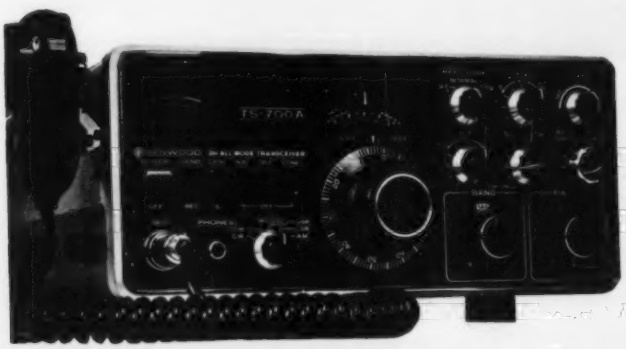
The value of its features and specifications are obvious. But just as important is the kind of quality that Kenwood builds in. Hundreds of testimonials on the air attest to its performance and dependability. You probably have heard of some of the same glowing praise.

The TS-520 operates SSB and CW on 80 through 10 meters and features built-in AC and 12VDC power supply.



TS-520 Specifications

MODES: USB, LSB, CW
POWER: 200 watts PEP input on SSB, 160 watts DC input on CW
ANTENNA IMPEDANCE: 50-75 Ohms, unbalanced
CARRIER SUPPRESSION: Better than -45 dB
UNWANTED SIDEBAND SUPPRESSION: Better than -40 dB
HARMONIC RADIATION: Better than -40 dB
AF RESPONSE: 400 to 2600 Hz (-6 dB)
AUDIO INPUT SENSITIVITY: 0.25μV for 10 dB (S+N)/N
SELECTIVITY: SSB 2.4 kHz (-6 dB), 4.4 kHz (-60 dB). CW 0.5 kHz (-6 dB), 1.5 kHz (-60 dB) (with accessory filter)
FREQUENCY STABILITY: 100 Hz per 30 minutes after warmup
IMAGE RATIO: Better than 50 dB
IF REJECTION: Better than 50 dB
TUBE & SEMICONDUCTOR COMPLEMENT: 3 tubes (2 x 6146B, 12BY7A), 1 IC, 18 FET, 44 transistors, 84 diodes
DIMENSIONS: 13.1" W x 5.9" H x 13.2" D
WEIGHT: 35.2 lbs.



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Hamming by Laser

-- modulating them isn't easy

Through a stroke of luck, my professor loaned me a Spectra Physics helium-neon one milliwatt laser for two weeks – an ideal opportunity for a ham to get hands-on experience with the old-fashioned but up-and-coming communication medium, "optics."

Lasers have found many applications in science and industry, from measuring stress, to 3D imaging, to distance measuring. It is not novel to send voice (or other messages) over a laser or other light beam, but my two week experiment might provide food for thought for other ham projects.

Fundamentals

Helium-neon lasers, for all practical purposes, put out only a single color of light (6328 Angstroms). It is this monochromaticity (single color) which allows differential measurement of small distances, by additive or destructive addition of light waves, as well as 3D imaging (holography). They also put out an extremely narrow beam of light, in comparison to that of a flashlight. So narrow, in fact, that even this inexpensive unit diverges to only 6" in diameter at 400 feet, or 6.4' at 1 mile. That is a beamwidth of .069° (4.1 minutes). That is a much narrower beamwidth than my 16 element 2 meter collinear. In fact, it is so narrow that you cannot possibly hold it steady enough in hand to use it to communicate 1 mile. You must use a tripod or other adjustable rigid mount to perform almost any experiment with it.

One milliwatt does not seem like much power output. Compare that with a flashlamp: 6 volts x .25 Amps x .10 efficiency = 150 mW output. Yet at 400 feet (the length of my street), the laser appears much brighter because of its narrow beam. The laser incident energy is 1 mW/182 cm^2 = .0055 mW/cm^2, while the flashlight energy (a very good one) is 150 mW/291863 cm^2 = .0055 mW/cm^2. The laser is 10 times brighter at 400 feet. Danger? Well, 1 milliwatt is completely safe impinging on your hands or fingers. But don't look directly into the beam from closer than ½ mile. Concentrated laser light can and will destroy the visual acuity of the retina. Also, be careful to avoid looking accidentally at reflections off mirrors.

Close-up of mirror and C-clamp mounted on speaker at transmitting end. 73 Magazines *are used to shim elevation of reflected light beam, which may be seen in center of mirror.*

Modulation

Now for the ham radio application. There are several ways to modulate a laser: 1) amplitude modulation; 2) pulsewidth modulation; 3) polarization modulation;[1] and 4) spatial modulation (angular deflection). Let's examine each.

Amplitude modulation of the laser is possible by varying the current through the laser tube. Modulation is adequately linear over a current range of 1 mA to 5 mA.[2] This current modulation is accomplished by modulating the 6000 V supply[2] with a high voltage tube.

Pulsewidth modulation of the laser may be accomplished by switching the supply voltage to the laser tube on and off. If done at a constant frequency, with the "on time" duration varied proportionally to the modulating voltage, 100% linear modulation is possible. In addition, for long distance communication, an i-f strip amplifier tuned to the repetition rate of the on/off switching can be used to amplify the output of a photomultiplier[3] to usable levels. You might cleverly choose 455 kHz as a pulse repetition rate, thus making an old transistor radio a practical i-f amplifier. Commercially available 100% modulated lasers only have an upper repetition rate limit of 100 kHz,[1] so 455 kHz would require customization.

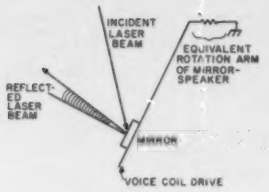


Fig. 1.

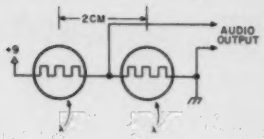


Fig. 2.

Close-up of laser, mirrored speaker, and receiver system.

Polarization modulation can be likened to changing antenna polarization from horizontal to vertical and back, based on microphone voltage. It is accomplished with a laser by first polarizing the laser output to horizontal by a polaroid filter, and then passing the light through a Kerr cell or Pockels cell (a nitro benzene mixture between very high voltage plates). The Pockels cell rotates the light polarization through an angle proportional to the voltage applied. At the receiving end, the light is passed through a second polaroid filter, and thus becomes amplitude modulated proportional to the speech input. Differential reception is possible to cancel stray light noise by using two polaroid filters at the receiver, one horizontal and one vertical, and subtracting the light energy of one from the other. Note that differential reception is desirable to cancel the effects of lights run from 60 Hz power, many of which exhibit nearly 100% 120 Hz modulation. The differential signal recovered is nearly constant across the beamwidth.

Spatial modulation, or angular deflection, means simply to deflect the beam through an angle proportional to the modulating voltage, preferably in the horizontal plane. For deflection angles less than the beamwidth (in this case, less than .069°), the light energy at the left and right edges of the beam is amplitude modulated. Again, differential reception is possible by subtracting left edge light energy from right edge light energy. The signal recovered is proportional to detector separation relative to the edges of the undeflected beam, and to the ratio of modulated laser light energy to ambient illumination.

Practical Application

Tearing into the university's laser to modulate the 6000 V supply was undesirable. This ruled out internal AM and PWM. External modulation by Pockels cells and Kerr cells, in addition to costing more, requires upwards of 1000 volts for 90° polarity rotation. That left spatial modulation. Commercial mirrors with magnetic drives were available. But, with ham radio zeal, I decided to glue a small 1 cm by 1 cm mirror near the voice coil of a 6" 5 Watt speaker with a 20 ounce ceramic magnet, thus ensuring minimal spectral distortion due to the additional mass of the mirror. This arrangement (Fig. 1) provided an angular rotation of the mirror surface which was small – but appropriate for reasonable audio power levels (50 mW).

Thus the mirror undergoes a small rotation for voice coil displacement. The audio power applied is adjusted to deflect the beam approximately half the beamwidth on maximum excursions.

At the receiver I utilized two matched ¼" cadmium sulfide photocells in series with 2 cm horizontal displacement to achieve a differential (hum canceling) photodetector (Fig. 2). Thus, if the detector connected to the +V receives more light, output voltage rises. If the grounded detector receives more light, output voltage falls. If both receive increasing or decreasing amounts of light, output remains constant.

This detector pair was soldered to a handy 4 transistor high impedance input audio amplifier (see Fig. 3). A similar one was used to drive

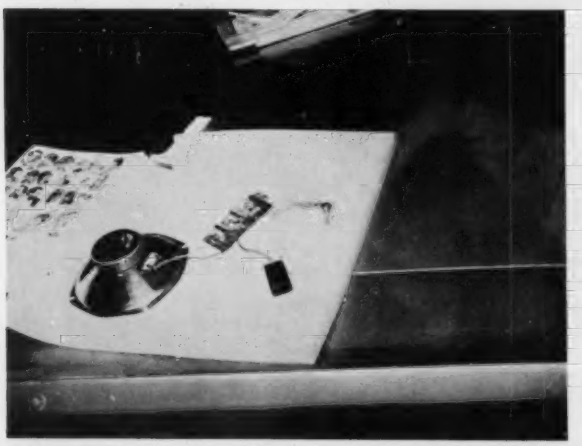
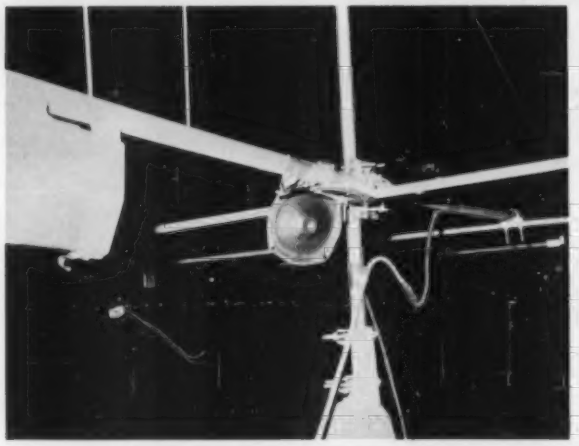
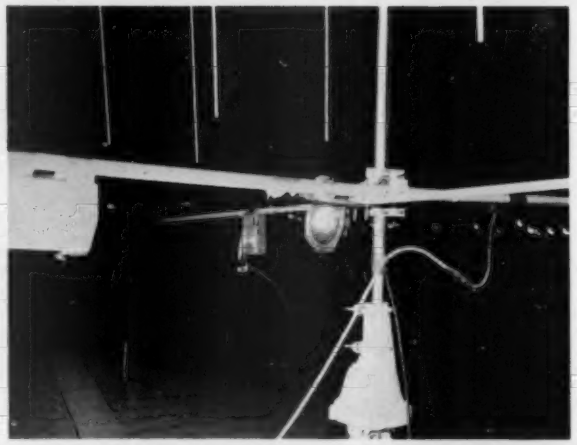


Photo of receiver showing four transistor audio amplifier, and cadmium sulphide photocells at input end. Loudspeaker, battery, and volume control may also be seen.

Laser light viewed at night from 400 feet down the street. Other lights are street lights.



Close-up of laser, speaker, and C-clamp mounted on 6m yagi.



Laser and speaker mounted on 6m yagi, with reflected laser light showing clearly in center of speaker.

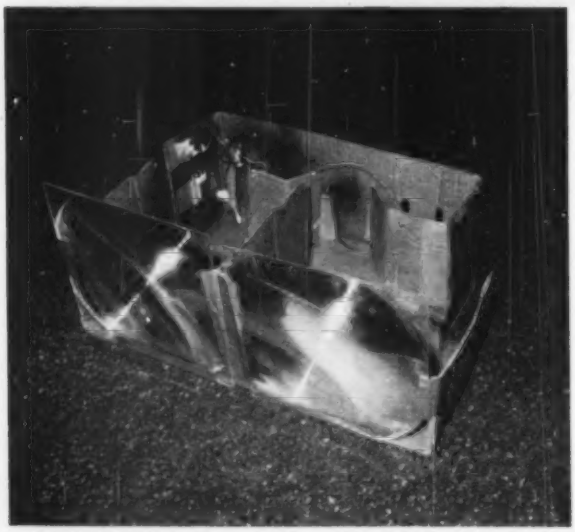
the mirror loudspeaker, with microphone input.

Aiming the laser to bounce off the mirror and go where you intend is the most difficult and time-consuming aspect of the project. A chemistry lab flask holder would be most helpful for holding the speaker, but a series of C-clamps and magazines served to shim it into position. A tripod would be quite useful for the laser, but some *73 Magazines* were adequate to shim it into position for a 400' test. Having carefully aligned the beam down the sidewalk (at night) with constant elevation, a QSO was conducted between a 2m HT and the laser. The recovered audio was excellent beyond the distance where the beamwidth fully covered both detector cells, out to the full length of the street (410 feet).

I next attempted to transmit the laser light to a nearby friend's home 1 mile away. This was accomplished by taping the laser, speaker and clamp to my 6 meter yagi, and rotating the antenna until the reflected beam pointed in the correct direction. Then, by standing on the roof and pushing up/down/back and forth on the element to which the C-clamp was taped, and listening to .94 feedback, I was able to position the reflected laser beam in my friend's direction. Generally speaking, ¼" of movement on the end of the yagi element moved the laser 50 feet at his end. Unfortunately, he was completely unable to detect audio on the laser beam with the photocell arrangement. There were clearly two problems: 1) the laser needed a hard mount, with the ability to move the receiving photocells to the beam center; and 2) the laser light needed to be reconcentrated for the cadmium sulfide photocells to be adequately responsive.

In order to reconcentrate the laser light, I purchased 2 Fresnel lenses with a 1000:1 concentration ratio, and mounted them in a cardboard frame. The cardboard frame also mounts the cadmium sulfide photocells at the focus of the concentration lenses, the audio amplifier and the loudspeaker.

We made special arrangements to use the ½ mile taxiway at the Falcon Field airport one night, so that the laser could be hardmounted and left pointing down the taxiway, while the receiver was moved to the center of the beam. Again, .94 feedback was used to achieve approximate aiming of the light beam. Elevation control of the light beam was most critical in this instance, since 5 feet too high would be unreachable with the receiver, and 5 feet too low would move the beam halfway down the taxiway. To achieve this critical elevation adjustment, a 3" x 5" card was slowly slid between the pages of the phone book supporting the speaker and C-clamp, until the correct elevation was reported from the receiving end. Now the receiving system with Fresnel concentrators was moved into position in the beam. The audio was *awful*. Examination of the beam, viewed upon my tee shirt, revealed considerable fluctuation in the beam due to air currents rising from the pavement. Apparently, the rising air currents created rarefactions of small enough diameter to effect one side of the differential detector, but not both simultaneously. Unaccountably, the audio quality of the output was best, and adequate, when one or the other of the photodetectors was covered, thus using the photodetector in the photo-voltaic mode instead of the photo-resistive mode.



Fresnel concentrator in cardboard frame, showing photocells, audio amp, and loudspeaker.

Conclusions

Spatial modulation of laser light must be considered the least expensive modulation technique through atmosphere. The apparent upper range limit with unsophisticated reception techniques is one mile at night, and con-

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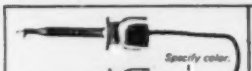

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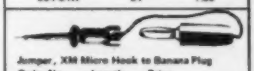
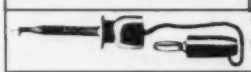
204-12W*	12"	$1.60
204-24W*	24"	1.80



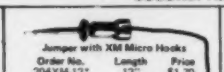
Jumper, XM Micro Hook to Banana Plug

Order No.	Length	Price	
201XM*	32"	$1.40	Specify color.



Jumper X-100W Mini Hook** to Stacking Banana Plug

Order No.	Length	Price	
201W*	32"	$1.35	Specify color.



Jumper with XM Micro Hooks

Order No.	Length	Price
204XM-12*	12"	$1.70
204XM-24*	24"	1.70

Specify color.

MINI HOOK

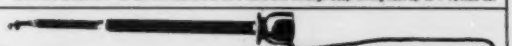
X100W Mini Hook (2.25" long) combines rugged construction, miniature size and Finger-eze Hypo Action for all the best test connections. Hook is large enough for component leads, yet small enough to get into tight places . . . . . $.75 ea.

Specify color. ORDER X100W

EXTRA LONG MINI HOOK ORDER XL-1

XL-1 Mini Hook (5.0" long) combines all the proven features of the X100W with an extra long body. It will make safe, short-free test connections in card racks and through deep wiring nest up to 4". $1.25 ea.

JUMPER WITH XL-1 MINI HOOKS



Order No.	Length	Price	
204XL1-12	12"	$2.80	
204XL1-24	24"	2.80	Specify color.

JUMPER, XL-1 MINI HOOK TO STACKING BANANA PLUG

Order No.	Length	Price	
201XL-1*	32"	$1.95	Specify color.

*Specify color. **Square hole tip for hooking laterally to leads or vertically over square wire-wrap pins.

COMPLETE SET $7.95

ORDER YOUR XM-S MICRO HOOK SET TODAY! (Includes 1 ea. red, black, blue, green, orange, yellow, white, brown, violet and gray Micro Hook) At this low price you can afford more than one set.

CONTINENTAL SPECIALTIES

PROTO BOARDS

Build & test circuits as fast as you think!

PB-6	6 IC cap breadboard kit	$15.95
PB100	10 IC cap breadboard kit	19.95
PB101	10 14-DIP cap, 5-way post, 840 solderless tie points, 5.8 x 4.5"	29.95
PB102	12 14-DIP cap., like PB101 with 1,240 tie points, 7.0 x 4.5"	39.95
PB103	24 14-DIP cap., 4 5-way posts, 2,250 tie points, 6.0 x 9.0"	59.95
PB104	32 14-DIP cap., 3,060 solderless tie points, 8.0 x 9.76"	79.95

LOGIC MONITOR 1

Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs. Packet size. $74.95

LOGIC MONITOR 2

Displays static and dynamic states of digital ICs such as C-MOS, HTL, TTL, DTL & RTL. Selectable threshold control. $124.95

LOGIC PROBE LP-1

Compact, circuit-powered multifunction logic probe. Multi-family compatability. DTL/TTL/HTL/CMOS. Traces logic levels and pulses through digital circuitry. $44.95.

SOCKETS & BUS STRIPS

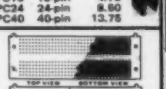
Plug-in, wire, test, modify or expand without patch cords or solder. Snap together to form breadboard needed.

PN/Description	Term'ls	Price
QT59S Socket	118	$12.50
QT59S Bus	20	2.50
QT47S Socket	94	10.00
QT47S Bus	16	2.25
QT38S Socket	70	8.50
QT35S Bus	12	2.00
QT18S Socket	36	4.75
QT12S Socket	24	3.75
QT8S Socket	16	3.25
QT7S Socket	14	3.00

PROTO-CLIP

For power-on/hands off signal tracing. Bring IC leads up from PC board surface for fast trouble-shooting.

PC14	14-pin	$4.50
PC16	16-pin	4.75
PC24	24-pin	8.50
PC40	40-pin	13.75



PROTO BOARDS

With built-in regulated short-proof power supplies

PB203	5V, 1 amp regulated power supply	$ 75.00
PB203A	5V, 1 amp and ±15V, ½ amp regulated power supply	120.00

DESIGN MATES

DESIGN MATE 1 . . . . . CIRCUIT DESIGNER
With built-in, regulated, metered power supply to design unusual circuits fast. $54.95

DESIGN MATE 2 . . . FUNCTION GENERATOR
Complements Design Mate 1. Produces clean, accurate wave forms with variable amplitude and frequency controls. $89.95

DESIGN MATE 3 . . . . . R/C BRIDGE
Saves design time by measuring and selecting capacitors and resistors so better than 5% instantly! $59.95

DESIGN MATE 4 . . . . . MULTIPURPOSE PULSE GENERATOR
With the precision and versatility of a laboratory instrument, ideal wherever a source of clean, fast output pulses compatible with virtually all logic families and discrete circuits is needed . . . $124.95

BREADBOARD JUMPER WIRE KIT
Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0". Each wire is stripped and leads are bent 90° for easy insertion. Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box. BK-1 . . . . . $9.95

CARBON FILM RESISTORS (5%)

Only in Multiples of 100 pcs per value (ohms)

¼W. . . . $1.69 per 100 • ½W. . . . $1.79 per 100

10	33	100	330	1.0K	3.3K	10K	33K	100K	330K	1.0M	3.3M
11	36	110	360	1.1K	3.6K	11K	36K	110K	360K	1.1M	3.6M
12	39	120	390	1.2K	3.9K	12K	39K	120K	390K	1.2M	3.9M
13	43	130	430	1.3K	4.3K	13K	43K	130K	430K	1.3M	4.3M
15	47	150	470	1.5K	4.7K	15K	47K	150K	470K	1.5M	4.7M
16	51	160	510	1.6K	5.1K	16K	51K	160K	510K	1.6M	5.1M
18	56	180	560	1.8K	5.6K	18K	56K	180K	560K	1.8M	5.6M
20	62	200	620	2.0K	6.2K	20K	62K	200K	620K	2.0M	6.2M
22	68	220	680	2.2K	6.8K	22K	68K	220K	680K	2.2M	6.8M
24	75	240	750	2.4K	7.5K	24K	75K	240K	750K	2.4M	7.5M
27	82	270	820	2.7K	8.2K	27K	82K	270K	820K	2.7M	8.2M
30	91	300	910	3.0K	9.1K	30K	91K	300K	910K	3.0M	9.1M

NEW IN STOCK PLESSEY

LOW COST INTEGRATED CIRCUITS FOR RADIO COMMUNICATIONS

Plessey SL1600 Radio Communications Circuits are used in all types of military, commercial and amateur radio systems. These same devices are now available in economical, easy-to-use plastic minidip packages. Now you can afford to make extensive use of Plessey circuits in the design of synchrodyne, superhet, SSB and multimode receivers, transmitters and transceivers.

114 PAGE APPLICATIONS MANUAL
Contains Circuit Data, System Design and Technical Data for SL 1600 series integrated circuits . . . $1.95

A TYPICAL TRANSCEIVER SYSTEM

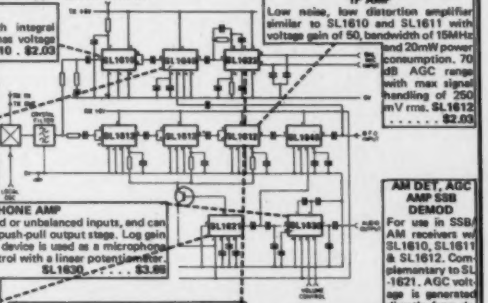
SSB transmitters and receivers of the same type contain many identical components. Therefore, by a little signal switching, it is possible to make one set of filters and SL1600 devices perform alternately as a transmitter and as a receiver — i.e. as a transceiver. This, of course, results in a real cost savings, both on SL1600 devices (which in any case are relatively inexpensive) and on filters (which are not!). These points are illustrated by the Figure below, a typical SSB transceiver, and also in Applications Manual Appendices B and D.

RF AMP
Low noise, low distortion, amplifiers with integral supply line decoupling and AGC, SL1610 has voltage gain of 10 and bandwidth of 140MHz SL1610 . $2.03

DOUBLE BALANCE MODULATOR
Replaces diode ring modulator, in RF/communications systems up to 75MHz. At 30 MHz, carrier and signal leaks are typically −40dB referred to the desired output product frequency. Intermodulation products are −45dB with a 60 mV rms input signal. SL1641 is similar for receiver mixer applications w/lower noise figure and power consumption. SL1640, SL1641 . . . . . $2.03

MICROPHONE/HEADPHONE AMP
Offers a voltage gain of 100, accepts balanced or unbalanced inputs, and can deliver up to 250 mW output from a class AB push-pull output stage. Log gain control allows AGC to be applied when the device is used as a microphone amplifier, and also allows remote volume control with a linear potentiometer. Gain reduction of 100dB may be obtained. SL1630 . . . . . $3.88

AGC GEN
SL1620 VOGAD is an AGC generator for use with the SL1630 in microphone amplifier. Maintains amplifier output between 70mV and 87mV rms over 35dB range. One second 'hold' period prevents increase of background noise during pauses in speech. SL1621 is for use in SSB receivers with SL1521, SL1611 and SL1612. Generates a suitable AGC voltage from the detected audio waveform, provides a 'hold' period, is immune to noise interference. Smoothly follows fading HF signals. SL1620, SL1621 . . . . $2.58



IF AMP
Low noise, low distortion amplifier similar to SL1610 and SL1611 with voltage gain of 50, bandwidth of 15MHz and 20mW power consumption. 70 dB AGC range with max signal handling of 250 mV rms. SL1612 . . . . . $2.03

AM DET, AGC AMP SSB DEMOD
For use in SSB/AM receivers with SL1610, SL1611 & SL1612. Complementary to SL-1621. AGC voltage is generated directly from detected carrier signal independent of depth of modulation. Follows the most rapidly fading signals. SL1610 and SL1612 maintain the output within a 5dB range for a 90dB range of receiver input signal. SL1623. . . . . $3.01

AF AMP, VOGAD SIDETONE
Accepts signals from a low-sensitivity microphone providing an essentially constant output signal for a 60 dB range of input. Constant gain amplifier provides an amplitude-limited output for sidetone in mobile transmitter/receiver applications. 10 lead TO-5 operates from a 6 to 12 volt supply, produces an independent supply line at 4.7 volts stabilized. SL1622 . . . . $3.01

Digital Auto Clock Build-It-Yourself Kit

A brand new solid-state Technology Kit from FAIRCHILD

AVAILABLE NOW — $40.00 COMPLETE

IC SOCKETS

			SOLDER-TAIL DIP				TO-5
			1-24	25	100		SOCKETS
WIRE-WRAP GOLD DIP			8	.21	.19	.17	TEFLON
PIN	1.24	25	100	14	.25	.22	.20	
14	.45	.41	.37	16	.28	.25	.23	
16	.54	.49	.44	18	.34	.31	.28	3 PIN .55 EA
				22	.37	.36	.35	8 PIN 1.10 EA
SOLDER — GOLD DIP				24	.47	.43	.40	10 PIN 1.40 EA
14	.34	.31	.28	28	.88	.80	.70	
16	.37	.34	.31	36	1.09	.98	.89	PLASTIC TO-5
				40	1.24	1.12	.90	8 PIN .40 EA

POWER SUPPLIES ADTECH

Model No.	Output Vdc	Output Amps	
APS5-3	5	3.0	
APS12-1.6	12	1.6	
APS15-1.5	15	1.5	$30.98
APS24-1	24	1.0	
APS28-0.8	28	0.8	
APS5-6	5	6	
APS12-4	12	4	
APS15-3	15	3	$50.40
APS24-2.2	24	2.2	
APS28-2	28	2	
APS5-10	5	10	
APS12-7	12	7	
APS15-6	15	6	$71.20
APS24-5	24	5	
APS28-4	28	4	

PLESSEY POLYESTER (CAPACITOR) MINI BOX

MF	V	$	MF	V	$
.001	1000	.14	.039	250	.18
.0012	1000	.14	.047	250	.18
.0018	1000	.14	.056	250	.18
.0018	1000	.14	.068	250	.19
.0022	1000	.14	.082	250	.17
.0027	1000	.14	.1	100	.17
.0033	1000	.14	.12	100	.18
.0039	630	.14	.15	100	.20
.0047	630	.14	.18	100	.21
.0056	630	.14	.22	100	.23
.0068	630	.14	.27	100	.26
.0082	630	.14	.33	100	.30
.01	630	.14	.39	100	.33
.012	630	.14	.47	100	.36
.015	400	.15	.56	100	.44
.018	400	.15	.68	100	.47
.022	400	.15	.82	100	.54
.027	400	.15	1.0	100	.60
.033	250	.15			

ANCRONA

Minimum order $10.00. Add $1.00 to cover postage and handling. California residents add 6% sales tax. **Mail Order** — Send Check or money order to: **P.O. Box 2208M Culver City, CA 90230 • Phone Order** — Call: (213) 641-4064. COD, Master Charge and Bank-Americard welcomed. *(Stores do not accept mail or phone orders.)*

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Culver City, CA 90230	Santa Ana, CA 92705	Tucson, AZ 85711	Portland, OR 97220	Atlanta, GA 30305	Vancouver, BC V5W 2Z4
(213) 390-3586	(714) 547-8424	(602) 881-2348	(503) 254-5541	(404) 261-7100	(604) 324-0505

siderably less in daytime. For these kinds of distances, wire is a more economical communication media than laser through the atmosphere, except where circumstances prohibit stringing wire or the bandwidth of the signal is considerably higher than conventional audio bandwidths. In turn, laser is less expensive than conventional superhet receivers and crystal-controlled transmitters for these distances. Laser communication is certainly more secure, since fundamentally all transmitted energy can be intercepted at the receiver site.

Want to try out a laser? I hope this article has given you ideas to build on! ■

References

[1] "Spectra Physics Technical Memorandum," 1966, Hobart; "Modulated Helium Neon Laser," Spectra Physics.

[2] Conversation with Spectra Physics engineer.

[3] B. Fette, "Getting Started on ATV," *73 Magazine*, November, 1973.

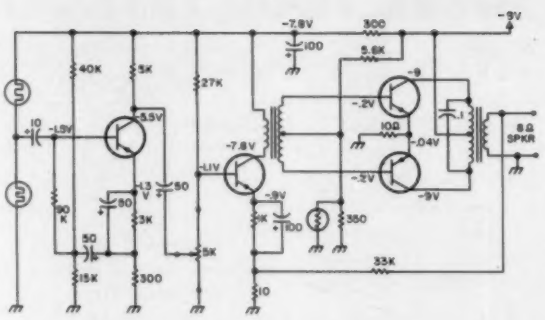


Fig. 3. High input impedance four transistor audio amplifier.

A 60 Foot Antenna on a 20 Foot Lot

- - solving a 40m Novice problem

One of the first hurdles for the newly licensed Novice is the matter of an antenna. Many beginners don't have a pair of 70 foot trees spaced just right for an 80-40-15 skyhook pointed in the right direction. Bearing in mind that there is no one more critical element to happy hamming than a good antenna, WN6GKE has come up with a solution.

The antenna is actually a half wave dipole for 40 meters, in a horizontal "U" configuration. (The same design will work on 80 meters, by doubling the dimensions.) With the help of an antenna tuner, the "U" will work 80-10. The 40 meter version requires two supports; trees or TV masts will do. Because of the antenna's "U" configuration, positioning is not important, since the tuning fork is omnidirectional.

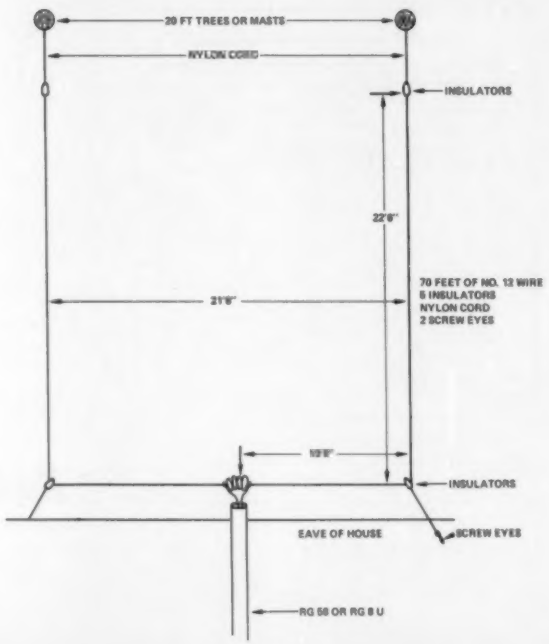
Construction

The feedpoint should be as far from metal objects as possible. When cutting wire for each leg of the antenna, add two feet of extra length. This will be used for trimming down the swr. Pulleys are very handy on the high ends of the antenna, in order to raise and lower the elements for tuning. Keep the spacing between elements at 21 feet 6 inches, but don't worry too much about the angle. Anything from 90 to 45 degrees will work.

Tuning

Set your transmitter on 40 meters at 7.125 MHz. Measure the swr using a bridge, and trim each leg of the antenna three inches at a time. Remember to cut both legs equally. Repeat this step until the swr is down to a level below 1.5 to 1.

Cost of the antenna, including 70 feet of #12 wire, 5 insulators, nylon cord, screw eyes and coax, was about $20, but it could have been made for much less. So, fellow Novices, if space and money are your problem, try tuning up with a "tuning fork" and get ready for some nice surprises! ■



Reprinted from Collector and Emitter, *Central Oklahoma Radio Amateurs, Inc., Box 15013, Oklahoma City OK 73115.*

RF POWER TRANSISTORS

PRICE	FIG	P_D MAX @25°C	POUT MIN @ 2 GHz	PIN	EFFICIENCY @ 2 GHz	REMARKS
$4.95	A	3.5W	1.0W	310mW	30%	Sim. to RCA 2N5470
$5.95	B	8.7W	2.5W	300mW	33%	Sim. to RCA TA8407
$6.95	B	21W	5.5W	1.25W	33%	Sim. to RCA 2N6269
$7.95	B	29W	7.5W	1.5W	33%	Factory selected part---2N6269

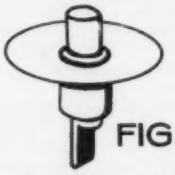


FIG A

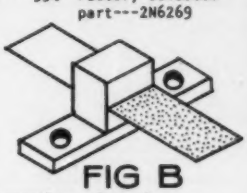
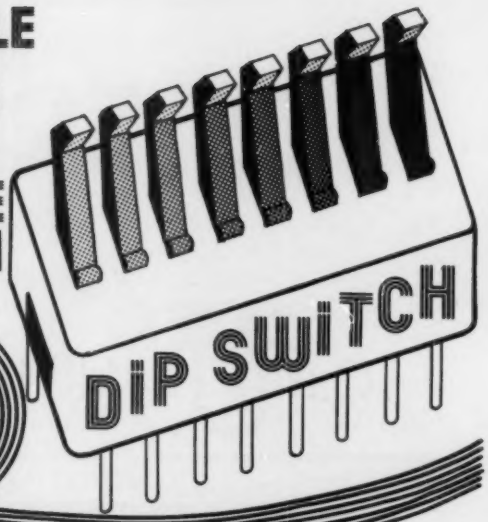


FIG B

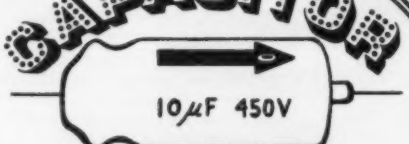
For operation at lower frequencies gain and efficiency are higher, giving higher output power.

EIGHT POLE SINGLE THROW TOGGLE ACTION



$1.95

CAPACITOR



3 FOR $1

Now you have a choice--specify wire wrap pins (illustrated) or solder-tail with .250" row spacing. For IMSAI and Altair peripherals. Wire wrap part # S-100WW. Solder-tail part # S-100ST.

COME AND GET 'EM...

100 PIN EDGE CONNECTOR

$5 EACH--$22 FOR 5

CAVE grafix™

factory fresh:

709 OP AMP 4/$1

74109 flipflop 4/$1

SPECIAL SPECIAL SPECIAL

12V 8A POWER SUPPLY CLOSE-OUT

One of our most popular kits is now making way for a new model. This is the last time you'll see this quality supply for $22.50 (also include postage for 24 pounds). Better than .05V regulation; current limited at 13A; adjustable output 11-14V; short protection; RF bypassing. NOTE: LIMITED QUANTITIES.

MINIATURE TOGGLE SWITCHES! $1.10 EACH- OR 5 FOR $5

New, with mounting hardware. Contacts rated up to 5 Amps at 120 VAC. MADE IN U.S.A.; similar to C&K #7101.

Switches of this quality seldom show up as surplus...here's your chance.

TERMS: Orders under $10 add 50¢ handling. No COD orders. Place Mastercharge® and BankAmericard® orders by calling 415-562-0636, 24 hours. California residents add appropriate sales tax.

GODBOUT

BILL GODBOUT ELECTRONICS
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While you're here...circle the reader service card. Our flyer will make it worth your while!

LETTERS

from page 10

it a lot easier ... so count your blessings. No mobile operation is permitted here. No operation outside of a military installation. And no communication by radio with Japanese amateurs. To an avid 2m FMer like myself, it is very frustrating. (Don't know how true it is, but I'm told that the reason we can't work Japanese stations is a story like this: It seems that some time in the '50s or '60s an American ham insulted a Japanese amateur on the air. Well, the Japanese ham happened to be the equivalent of our FCC Chief of the Amateur and Citizen's Division, and a *Japanese* law came into being shortly after that Japanese hams will not communicate with US hams stationed within Japan. In the spirit of cooperation, American military hams are told they will not work Japanese stations. There are no other operating restrictions on what country you work, other than the ones all American hams follow.) Incidentally, CB operation is *prohibited* here, so if you are coming over ... leave it home.

So it appears the only way I can get on the air here is through OSCAR. That is, just using the equipment I already have. I brought my TR-22 with me, and my friend Steve KA6XX has a Kenwood TS-520 he had already set up in the MARS station on post. If we can hear the satellites, I'm going to modify my TR-22 for CW, and have at it. It'll be my first time working OSCAR.

MARS is very active here, and a warm thank you to all the hams who ever helped MARS anywhere. I remember what I used to think of MARS in the states ... and it has taken on a new importance and vitality for me here.

I'm a Tech, and hoped to get my Conditional over here. However, with the Conditional dead, I'd have to get to Guam to take my test ... so I guess I'm stuck ... it's not all that bad — Techs have all General CW privileges here.

There are two good things ... equipment is inexpensive, and you can pick your own callsign, due to the scarcity of US hams here.

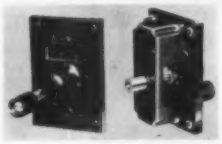
Thanks, and see to it that *73* is always around.

Mark R. Wheeler WB2ULR
APO San Francisco

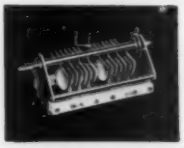
G.R. WHITEHOUSE & CO.

17 Newbury Drive, Amherst, N.H. 03031

TRANSMITTING VARIABLES



Millen 16250 dual 255pF 3kV $43.25
Millen 16520A single 200pF 3kV ... 24.75
Johnson 154-10 single 347pF 3 kV .. 34.60
Johnson 154-507 Dual 200 pF k V ..46.20



COUNTER DIAL

Millen 10031, 0-99 turns readout with 0-100 vernier dial, ideal for transmatch, fits ¼" shaft $25.50

LOWEST PRICES

JOHNSON SINGLE SECTION 800 V

160-102 1.5 -5 pF	$3.00
160-104 1.8 -8 pF	3.05
160-107 2.3 -14 pF	3.15
160-110 2.7 -19 pF	3.20
160-130 3.0 -32 pF	3.45

BUTTERFLY

160-203 1.5-3 pF	$3.10
160-205 1.8-5 pF	3.30
160-208 2.2-8 pF	3.50
160-211 2.7-10 pF	4.50

DIFFERENTIAL

160-303 1.5-5 pF	$3.20
160-305 1.8-8 pF	3.60
160-308 2.3-14 pF	4.00
160-311 2.7-19 pF	4.50

HAMMARLUND SINGLE SECTION 1200 V

MC 20S 3.5 -20 pF	$8.40
MC 35S 6.0 -35 pF	8.50
MC 50S 6.5 -50 pF	8.60
MC 75S 8.0-80 pF	8.80
MC100s 8.3-100 pF	9.30
MC140S 10 -140 pF	9.40

MILLEN SINGLE SECTION 800 V

19100 8 -100 pF	$11.40
19140 9.7-148 pF	12.00
19335 15 -339 pF	17.15

J. W. MILLER

1460-1 3gang 6-21 pF	$6.48
2101 1gang 11-105 pF	18.00

Many other values from these designs in stock.

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Johnson Style 229-203, 28 mH $32.00
2KW ANTENNA TUNERS
Millen 92200 ..... 199.00
DUMMY LOAD WATTMETER
B&W Model 374 1.5 kW 0-300 MHz 215.00
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3003 $1.85	3016 $2.10
3011 1.90	3021 2.20
3012 2.05	3025 4.45
3014 1.85	3029/3905-1 5.05
3015 1.95	

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B&W FC30A twin dual winding 30 A 29.00
R-F PLATE CHOKES
B&W 800 90 mH 2.5 kV 500 mA $8.75
National R175A 145 mH 3 kV 800 mA 10.60

We offer the identical product as the other house at about ONE HALF THE COST

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T130-2	1.15	T50-10	.30
T106-2	.75	T50-12	.30
T106-3	.75	T44-2	.25
T94-2	.50	T37-2	.25
T94-6	.50	T37-6	.25
T80-2	.40	T37-10	.25
T80-3	.40	T37-12	.25
T68-2	.35	T25-2	.20
T68-3	.35	T25-12	.20
T68-6	.35	T12-2	.15
T50-2	.30	T12-2	.15
T50-3	.30		

Ferrite Toroidal Cores

Size	Price
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FT-50-72	.35
FT-82-61	.40

Ferrite Shielding Beads

Size	Price
FB-73-101	$1.00 Doz.
FB-43-101	1.00 Doz.
FB-73-801	1.50 Doz.
FB-43-801	1.50 Doz.

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A LOVELY COVER

Mr. Harry Goldman has managed to tell us a number of new facts about Tesla, which is quite a feat. Most of what we get is a capsule subluxation of H. Gernsback, who knew him best. Goldman's research and understanding make his article a landmark.

I have been told, long ago, that TESS-la is not the proper pronunciation, that TESH-la is. I don't know any Croatian, so I don't know this for sure.

One thing I do know: Tesla invented the roller coil tuning inductance. He shows it on a patent drawing for a wireless invention. He doesn't mention it in the patent papers, other than to say that the inductance was "variable," but the handle on the end could have turned nothing else but the cylinder itself. The lower frequency Command transmitters used this coil for antenna tuning. The WE D-156000 SSB trans-

mitter used a number of them. I have seen at least five different designs in all.

What's more, the November issue has a lovely cover.

Jake Bach
Walden NY

TERRIBLE!

Please pass along congratulations to Ken Cole W7IDF, for his vy FB story "Paolo" in the November 1976 *73*. His prose was a delight to read, his description of wartime action fantastic! Please, more!

Contrast that with "See the World and Get Paid" by Hargett in the same issue. What a thudding bore. That article would definitely keep me from looking into the Merchant Marine. Terrible.

Joe Koziol W1FLX
Pittsfield MA

Maybe we'll make a regular column for the Merchant Marine. — Wayne.

KUDOS TO MESHNA

I built the Keycoder I described in the July '76 issue of *73* and it works as advertised. Kudos to John Meshna & Co. for his excellent service in providing key components.

Wonder if any other builders have experienced EMI problems on 20 meters and above with the unit. Flawless operation on 40m; however, on 20m and above, keyer latches up on most alphanumerics due to proximity of keyer to rf from my Swan 500CX.

Short of shielding the entire keyer with aluminum foil or the like, wonder if other builders have suggestions on EMI protection for the timer and/or keying ICs.

Keep up the good work.

E.V. Shaparenko W6LQP
255 S. Rengstorff
Mountain View CA 94040

THE GRIPER

In May 1976, I subscribed to *73 Magazine* because of your I/O section and the basic, easy to understand computer articles it contains.

Now in your Nov '76 I/O Editorial you say you are going to have less computer articles in *73 Magazine*, and are going to publish a new computer-oriented magazine.

I feel this is unfair to the people who subscribed to *73* because of the I/O section.

There are some of us who would like to see more computer-oriented articles in *73*.

F. M. Gamer
Salina KS

It won't be much less, so stop griping. — Wayne.

WORTH THE MONEY

Enclosed with this letter you'll find a subscription to *73* and *Kilobaud*. I've been buying *73* for the past year at a local ham store, and you've convinced me. If *Kilobaud* is anywhere near the quality of *73*, it's well worth the money.

Two months ago I passed my Technician test and I'm still waiting for my call letters. Seems like a burn. When a CBer sends his four bucks in he can go on the air, and a commercial operator can talk as soon as he passes his test, but not a ham! We pass our test and give our four bucks and get a pat on the back. It's not fair!

Your code tapes were a real help. I tried for the longest time to learn code from other tapes and records, but your tapes are wonderful.

Your reply to WB8SWD's letter (pg. 19, Nov. *73*) is one of the main reasons that I support *73*. I'm convinced that we must use our VHF and microwave bands or they won't be ours for long. I disagree with you only on the discontinuance of the "mail order Tech license."

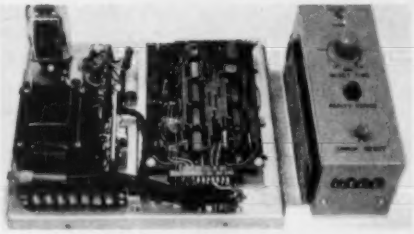
I found that local amateurs openly

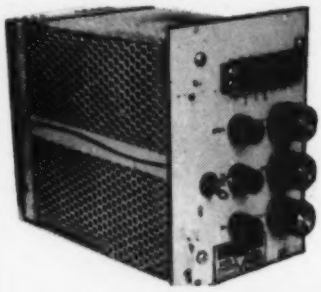
FAX MACHINE BY DATAFAX

We have transmitters and receivers. Used for weather charts, hi speed teletype recording. Normally used over the phone lines. Operational when removed due to upgrading of equipment. Only a few on hand and sold "AS IS." When used over the phone lines from weather data system, will draw full map of the US with cloud cover and also pressure gradients. Due to the weight of these machines they must be shipped via truck as they are around 60 lbs. Made for desk top use. Made by Steward Warner Elect. Picture is typical unit. When ordering state receiver or transmitter. #FAX $125.00 FOB Lynn Mass.

PARITY DETECTOR

New packaged, made for RCA, detects even or odd parity, baud rate 110, 150 or 134.46. Built-in logic supply for the ICs, operates from standard 115 Vac. Control panel allows manual or automatic reset mode of operation. Aluminum enclosure (not shown) covers the electronics. TTY compatible. Ship wt. 10 lbs. ~~$10.50~~ $12.50





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Designed for the space program, these are the highly efficient silicon high output cells. Used for powering equipment, charging batteries. Made by Ion Physics Corp. Each with spec sheet.
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Size .788 x .788" 125 mA, .43 V $1.60 12/$15.00

ZENER 15V 63 Watt $1.00
2.5 Amp 1,000 piv diode ..... 4/$1.00, 25/$5
Motorola 1N4001 diode 1A, 50 piv ..... 20/$1.00

RT 70/GRC as written up in 73 Magazine, November, 1976. Only $20.00.

Please add shipping cost on above.
FREE CATALOG SP-9 NOW READY
Meshna P.O. Box 62 E. Lynn, Massachusetts 01904

refused to give the test for Technician when it was mail order. They claimed that no one would practice code with a Tech license, so Novice was the only way to go. Now with the opening of the Novice code bands to Technicians, there's no excuse for discouraging Techs!

I'm an experimenter, not an appliance man. I consider *73* to be a real learning tool, a chance to increase our knowledge of electronics and communication, a far cry from the dull lists of call letters and contests in *QST!*

Howard Gerber
Houston TX

Hey, don't discourage QST *from long lists of call letters — I like 'em. — Wayne.*

OBVIOUS GROWTH

Having recently re-subscribed to *73* after a lapse of 7 years or so during which I was not active in hamming other than radio control on 6 meters, I would like to compliment you on the obvious growth of your magazine. I am fully in favor of the I/O articles and have just sent in a subscription for *Kilobaud*. I work for Aeronutronic-Ford Corp. on an Air Force contract operating tracking stations. I have just been transferred to Thule AFB, Greenland, for an 18 month tour, and would like to set up an OSCAR station here.

Can you recommend any books that can give me info on the operation of these satellites or perhaps the address of the group responsible for their development and operation? With my location (400 miles from the pole), I am in a position to work the vehicles on almost every orbit. I have equipment but have to decide on antennas. I am in the final phases of assembling my uP system based on the MOS Technology KIM-1 module, with expanded memory from Godbout and UART/TVT III from Mini Micro Mart. Per your editorial comment in the Nov '76 issue of *73*, I will detail in a later letter all the problems involved with the various mail order houses.

In closing, would appreciate any help in info on OSCAR. Keep up the info on new technology even though people scream. After 12 years in the satellite business, I know that you have to stay on top of the new developments or you are lost. In just 12 years, my job has progressed from tubes and 200 MHz to uP and 2.2 GHz — and it involves constant schooling and study just to keep up.

E. A. Zeitler KG6JCQ
Box 1337 AFSCF OLAA
APO New York 09023

Your best source of info is AMSAT, the Radio Amateur Satellite Corporation down in Washington, DC. Their address is AMSAT, PO Box 27, Washington DC 20044. They publish a quarterly newsletter and provide the orbit information which appears each month in 73. Speaking of 73, one of our most popular past issues covering OSCAR was back in July, 1975. More recent articles have covered ways to program calculators to plot OSCAR orbits. — Ed.

TROUBLE AHEAD

It looks like the NBS people changed their minds that the turning point of this sunspot cycle would have been this summer. A notice I got from them yesterday gave a forecast of sunspot numbers from August to next May, and they are forecasting even lower sunspot numbers for this winter than we had last winter. This agrees with what I told you.

I had a two day visit in June from the chairman of their forecasting committee to discuss my forecasting technique. I showed him how I do it. He also asked me for my opinion on this sunspot low and I told him the same thing that I told you . . . a long deep low followed by a low high.

John H. Nelson
Whiting NJ

John Nelson prepares our monthly propagation forecasts. — Ed.

2 METER CRYSTALS

FREQUENCIES IN STOCK

146.01T
6.61R
6.04T
6.64R
6.07T
6.67R
6.10T
6.70R
6.115T
6.715R
6.13T
6.73R
6.145T
6.745R
6.616T
6.76R
6.175T
6.775R
6.19T
6.79R
6.22T
6.82R
6.25T
6.85R
6.28T
6.88R
6.31T
6.91R
6.34T
6.94R
6.37T
6.97R
6.40T
6.46T
6.46R
6.52T
6.52R
6.55T
6.55R
6.58T
6.58R
6.94T
7.60T
7.00R
7.63T
7.03R
7.66T
7.06R
7.69T
7.09R
7.72T
7.12R
7.75T
7.15R
7.78T
7.18R
7.81T
7.21R
7.84T
7.24R
7.87T
7.27R
7.90T
7.30R
7.93T
7.33R
7.96T
7.36R
7.99T
7.39R

FOR THESE RADIOS

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Drake TR-33 rec only
Drake TR-72
Genave
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Lafayette HA-146
Midland 13-505
Regency HR-2
Regency HR-212
Regency HR-2B
Regency HR-312
Regency HR-2MS
S.B.E.
Sonar 1802-3-4, 3601
Standard 146/826
Standard Horizon
Swan FM 2X
Tempo FMH
Trio/Kenwood TR2200
Trio/Kenwood TR7200

Note: If you do not know type of radio, or if your radio is not listed, give fundamental frequency, formula and loading capacitance.

CRYSTALS FOR THE IC-230 SPLITS IN STOCK: 13.851111 MHz; 13.884444 MHz; 13.917778 MHz; HEATHKIT HW2021 600 KHz. OFFSET 11.3 MHz; $6.50 ea.

MASTER GAINER

MODEL GG-144A — Deluxe, Two Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1¼" O.D. SO-239 coax connector. $52.95

GG-144A

STANDARD GAIN MOBILES
Two Meters
- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—50 watts FM

MODEL SBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $28.75

MODEL SBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $26.95

SBLT-144 SBL-144

THF

VHF/UHF ANTENNA—TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. $16.95

SUPER GAIN MOBILES
Two Meters
- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-148 MHz
- SWR at resonance—1.1:1 typical
- Power rating— 200 watts FM

MODEL ZS-144
Same characteristics as CGT-144 supplied with ⅜-24 base to fit all mobile ball mounts — Length is 85" — Mount and cable not included. $28.75

GG-144

HUSTLER "BUCK-BUSTER"

MODEL BT-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included). $12.75

BT-2

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. $14.85

HLM

DELUXE MOBILE MOUNTS
For medium length, light weight antennas with ⅜"—24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached. $12.09

TLM

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180 swivel ball. $7.50

GCM-1

HUSTLER

HF
VHF
UHF
AMATEUR ANTENNAS

Each Hustler antenna design is specifically optimized for amateur band performance. Every assembly is manufactured from the best available materials under carefully controlled quality standards to give you superior mechanical and electrical performance. For more than a decade, reliability has been our foremost desire!

UHF-1

VHF/UHF ANTENNA—ROOF MOUNT
MODEL UHF-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 17' RG-58-U. $10.15

SHIPPING

We can ship C.O.D. first class mail. Orders can be paid by: check, money order, Master Charge, or BankAmericard. Orders prepaid are shipped postage paid. Phone orders accepted. Crystals are guaranteed for life. Crystals are all $5.00 each (Mass. residents add 25¢ tax per crystal). U.S. FUNDS ONLY

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Social Events

LIVINGSTON NJ
DEC 3

The Livingston Amateur Radio Club will hold its second annual electronic flea market on Friday, December 3, at 7:30 pm at the Livingston Memorial Recreation Building. For further info, contact Jeff Gehl WN2AXL, (201)-267-0280.

BROOKLYN NY
DEC 19

The Kings County Repeater Association will hold an indoor flea market on Sunday, December 19, 1976, from 9 am to 4 pm. Located at 910 Union Street, Brooklyn NY (at Grand Army Plaza). Sellers $3.00, buyers $1, children free. Refreshments available. Talk-in on 146.43 and 146.52.

FORT WAYNE IN
JAN 23

The annual Fort Wayne Winter Hamfest will be held at Shiloh Hall north of Fort Wayne, Indiana on January 23, 1977. Hours are from 9 pm to 4 pm local time, and early parking is available. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC-ARTS). Admission is $1.50 by advanced ticket, or $2.00 at the door. Table space is available for vendors at $1.00 per half-table (about four feet). For more information or advanced tickets and table reservations (held until 9:30 am), write to Hamfest Chairman, AC-ARTS, Inc., P.O. Box 342, Fort Wayne, Indiana 46801.

CORPUS CHRISTI TX
FEB 4-6

The Texas VHF-FM Society will hold its winter meeting at the Holiday Inn, Emrald Beach, 1102 S. Shoreline, Corpus Christi, Texas, on February 4, 5, 6, 1977. For further information contact: James Linthacum W5LCN, 1802 Daly, Corpus Christi, Texas 78412.

MANSFIELD OH
FEB 6

The Mansfield Ohio Mid Winter Hamfest Auction will be held February 6, 1977 at the Richland County Fairgrounds, Mansfield, Ohio. Prizes, flea market, auction – large heated building. Doors open 8 am. Talk-in 146.34/.94 and .52/.52. Tickets $1.50 in advance, $2.00 at the door. Contact Harry Frierhen K8JPF, 120 Homewood, Mansfield, Ohio 44906 or phone (419) 529-2801 or (419) 524-1441.

GRIFFITH IN
FEB 19

The Lake County Amateur Radio Club's 24th annual banquet is Saturday, February 19 at 6 pm, at the Griffith Knights of Columbus Hall, 1400 South Broad Street, Griffith, Indiana. All the delicious home-cooked food you can eat, wine fountain, entertainment, guest speakers, special awards, door prizes, cash raffles and a dance band after. Tickets are $7.50 each: no door purchase. Write (prior to Feb. 3) to Herbert S. Brier W9AD (W9EGQ), 409 S. 14th Street, Chesterton IN 46304.

DAVENPORT IA
FEB 27

The annual Davenport Radio Amateur Club Hamfest will be held Sunday, February 27, 1977 at the Masonic Temple in Davenport, Iowa. Admission is $1.50 advance – $2.00 at the door. Talk-in on 28/88 and 52. Refreshments and tables are available. For info and tickets send SASE to Dick Lane WAØGXC, 116 Park Avenue, So. Eldridge IA 52748.

FORT WALTON BEACH FL
MAR 20

The Fort Walton Beach Swapfest will be held Sunday, March 20, 1977. For further information contact Playground Amateur Radio Club, PO Box 873, Fort Walton Beach FL 32548.

★ 'ORLANDO HAMCATION 77' 'ORLANDO HAMCATION 77' 'ORLANDO HAMCATION 77' ★

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AT THE SHERATON'S TWIN TOWER HOTEL & CONVENTION COMPLEX, NEAR THE CROSSROADS OF THE FLORIDA TURNPIKE AND I–4 INTERCHANGE, IN ORLANDO FLORIDA.

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Main Ballroom Exhibit & Hamfest Area Opens Daily At 9AM
Swapfest Area Opens At 7AM Daily, And Friday Nite At 6PM.

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FOR THE BEGINNERS AND UP

★ *ARRL FORUMS*
THREE PLANNED FOR SATURDAY PM

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TOO MANY TO MENTION !

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Advance registration $3, at the door $4, per adult. Swapfest tables $5 per day.

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Hamfest Secretary,Georgia Denman K4ZXS, 405 Enka Way,Orlando Fla. 32811

MAKE ALL CHECKS FOR ADVANCED REGISTRATION AND SWAPFEST TABLES, PAYABLE TO 'THE ORLANDO AMATEUR RADIO CLUB INC,' AN INFO PACKAGE WILL BE RETURNED WITH ALL REQUESTS.

FOR SHERATON TWIN TOWERS HOTEL RESERVATIONS, WRITE DIRECTLY TO:
The Sheraton Towers, 5780 Major Blvd. Orlando, Fla. 32805
Rooms, Single $28, Double $36,per day. CALL TOLL FREE 800–325–3535

*SWAP FEST AREA WILL BE OPEN FRIDAY NIGHT FEB.11 FROM 6PM, no additional charge other than registration or a Saturday swap table ticket.

★ 'ORLANDO HAMCATION 77' 'ORLANDO HAMCATION 77' 'ORLANDO HAMCATION 77' ★

I/O REPORT

from page 76

version of SCELBAL). Will it do the trick for writing game programs, business programs? Does it have string capability? Etc. Anyway, with the 8008 SCELBAL coming on the scene, it would seem that we have even another good reason to get those "down" MARK-8s up and running.

AGAIN . . . WHERE'S ALL THAT SOFTWARE?

We've seen programmers (both amateur and professional) sit down and develop Tiny BASIC interpreters in a matter of weeks. I have the feeling that there has been a lot of applications software developed, too . . . it's just not being marketed like some of the language processors (Tiny BASIC, in particular). We all would like to have some useful and practical programs for our home systems (education, entertainment, etc.), and the need for small business software is acute, to say the least. Those who could use it are surely willing to pay for it. Those who have developed it would surely like to sell it. The *73/Kilobaud* Software Library would surely like to market it . . . at a reasonable price . . . and pay the programmer/author a hefty 15% royalty.

We're going to have articles in *73* and *Kilobaud* discussing this library, and how we can all benefit from it. The main objective is to get as much software out to the small computer community as possible via *national* distribution media (*73* and *Kilobaud*). To encourage and help along the development of small business systems is another objective, and I don't feel *anyone* has to worry about helping the "competition" . . . for crying out loud, there's more than enough out there for everyone. Along this same line, if you have some business applications software to sell, there's no reason why you can't go ahead and advertise and sell what you can through your own efforts, and submit it to the *73/Kilobaud* Software Library, also. Just that much more additional income from the program, right?

It's kind of interesting how a reaction is almost automatic when mention is made of small business systems. When I'm speaking to a group and the subject comes up, I almost invariably have several people come up afterward to get more information. My references to small business applications in previous I/O Reports have generated a variety of responses from interested people around the country, too.

A BIG ONE!

It's finally all coming "home." The first major personal and home computer conference and exhibition to be held in the San Francisco area (where most microprocessors are "born") will be coming along on April 15-17, 1977. *The First West Coast Computer Faire* is being put together by Jim Warren, Editor of *Dr. Dobb's Journal*, and Bob Reiling, Editor of the Homebrew Computer Club *Newsletter*. It's being sponsored by a number of local and regional hobbyist clubs, educational organizations, and professional groups . . . and supported by *73* and *Kilobaud*. One of the areas of big interest will be *ham radio applications* with microcomputer systems. For more information, contact: Jim Warren (415) 85107664 or (415) 323-3111, or Bob Reiling (415) 967-6754 (evenings) . . . or stay tuned for complete details in next month's I/O Report.

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VANGUARD has a frequency synthesizer that will save you time and money. It will give you 8000 thumbwheel selected channels from 140.000 to 179.995 MHz in 5 kHz steps at .0005% accuracy and your cost is only $179.95. Our standard model is for receivers with the crystal formula Fc = Fs - 10.7 MHz divided by 3. However, we can make it for almost any other formula.

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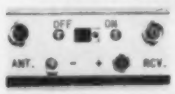

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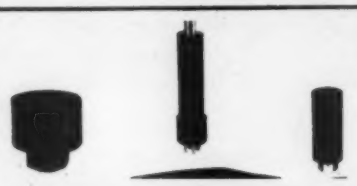

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Dual Voltage Power Supply

-- about as simple as they come

Certainly one of the more enjoyable, educational, and fascinating aspects of amateur radio is experimenting and home brewing with low cost readily available digital and linear integrated circuits. This regulated dual voltage power supply can start you off experimenting with the more common TTL integrated circuits and the increasingly popular CMOS integrated circuits. In addition, the higher voltage available from the power supply is good for a vast number of linear IC projects.

The power supply uses two type 309K three terminal regulator integrated circuits. These consist of an in, out and common pin connection and thus this IC is the simplest possible device to work with. The K suffix designates the type TO-3 package. This regulator is also available in the type TO-5 package, but we will use the higher power package to obtain output currents in excess of one Ampere. This is a particularly fine power regulator specifically built for five volt output for TTL use but a simple connection allows the regulator to furnish higher output voltages with equally excellent regulation.

The 309K three terminal regulator is rated by the manufacturer at output currents in excess of one Ampere and employs internal current limiting, thermal shutdown and safe-area compensation. All of this means that it is essentially indestructible. It also does not require a lot of external components, unlike most other regulator circuits. It requires only two resistors to provide a higher output voltage. All told, this is one of the easiest to build fully regulated and self-protected power supplies around.

There are no critical layout precautions. If the supply should exhibit a tendency to oscillate as evidenced by erratic operation, simply connect a 0.22 uF capacitor directly from input pin one to ground as close as possible to the regulator.

If you can scrounge up some of the parts from your junk box, you are already ahead of the game, but later on you will see how all of the parts may be obtained from a source near you to make it as easy as possible for you to get started experimenting. When all parts are on hand, you can assemble and package them in any way you like.

The power supply schematic may look a little strange to you, but do not be alarmed. This is a solid state version of the so-called "economy" power supply, more popular several years ago than it is today. It is a combination of the well known bridge and full wave rectifier circuit configurations. One regulator is connected to the transformer secondary winding center tap to yield five volts at the output for TTL circuits, and makes use of two of the diodes in the bridge rectifier to work as a standard full wave rectifier circuit. The other regulator is connected to the output of the bridge rectifier to yield about 14 volts at the output for CMOS and linear circuits. This regulator is biased up from ground by the two resistor divider network across the output. The regulated output voltage is adjustable by virtue of the variable resistor. The regulator requires a minimum voltage differential of about two volts between the regulated output and the dc voltage at input pin 1 from the output of the rectifier diodes and filter capacitor.

Most CMOS integrated circuits are rated by the manufacturer at 15 volts maximum, and it is wise to limit the output voltage of the power supply to not over, say, 14 volts. A voltage between 12 and 14 is good in order to take full advantage of the exceptionally high noise immunity of CMOS integrated circuits, and is also a good operating voltage for linear IC projects. The variable resistor may be replaced with a fixed resistor of equal in-circuit value, if it is not desired to vary the

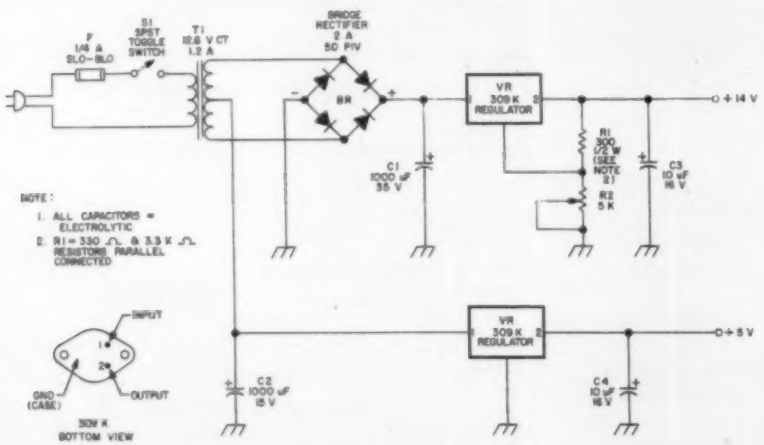

Fig. 1.

output voltage. Temporarily connect a variable resistor and adjust it to set the regulator output voltage as read by a voltmeter. Shut off the power supply, remove and measure the value of the resistor and solder in a fixed ½ Watt resistor of the nearest standard value.

Notice that the common terminal of the 309K is also the case of the regulator, so it is necessary to insulate the higher voltage regulator from the heat sink. For this purpose use the insulator found in the power transistor mounting hardware kit. Spread a very thin coat of heat sink compound (silicone grease) on each side of the insulator before mounting the regulator to the heat sink. Use the power transistor sockets to save soldering directly onto the pins of the regulator. This usually results in a messy-looking job. Perhaps a more important reason for using the sockets is that they have self-aligning insulated hubs that center the pins as they pass through the holes in the heat sink. The socket also insulates the mounting screws from the heat sink and prevent shorts from this cause.

If you yearn to try many of the wonderful devices described in ham magazine construction articles but are disillusioned, as I am, by the difficulty in obtaining all of the necessary parts, take heed — all is not lost. Building this power supply is about as simple as can be. All of the parts are available from Radio Shack. Surely one of these stores is conveniently near if not actually within walking distance of your shack. There is nothing wrong with mail order purchases when that is the best way to obtain specific parts, but buying direct does save time and postage. Any equally rated part can be substituted to build the power supply. So have fun and start experimenting. ■

Peter Walton VE3FEZ
421 Lodor St.
Ancaster, Ontario
Canada L9G 2Z9

Kints and Hinks

- - for money savers

Have you ever been faced with the situation of wanting to rescale an old junk box meter to suit a particular application or project?

Most hams have a few old meters kicking around deep in the bowels of the junk box that could be easily rescaled to suit present needs or interests.

I have found a relatively simple method of accomplishing this objective with a minimum of skill and artistic ability. The answer lies in the local stationery store, or perhaps even as close as your secretary's desk. It is in the form of a product called "liquid paper."

Liquid paper is basically a very fast drying white paint that is used by just about all secretaries to obliterate typing errors. You can use it to obliterate the old meter scale. Just paint a new white surface right over the old scale; it dries in a matter of seconds.

Now that you have the old scale painted out, you can easily add your own new one by means of dry transfer lettering which is readily available at any engineering or drafting supply store.

Using a bit of patience and some good old-fashioned pride in your work, you can come up with a really professional-looking meter face.

At today's prices, it really pays off to rescale an old meter.

Everyone knows how difficult it can be to find a small knob that's just right for the end of an adjustable coil or capacitor. Next time you see your wife tossing out an empty aerosol can, grab it.

Pull off the little push-button on the top of the can and put it in your junk box for future consideration. These little knobs can be drilled and epoxy glued to fit just about any small shaft you can think of.

You can also drill them and use them as insulating spacers, or even glue them to the bottom of a small cabinet and use the little devils as feet.

I have one stuck on the end of a home brew two meter whip antenna that I use on my portable. It saves me from getting my eyes poked out.

The XYL might think you're crazy, but these little buttons have lots of uses in the shack.

Have you ever attempted to locate a source for that nice springy stainless steel wire that is used in the makeup of two meter quarter wave whips?

Would you believe that it can be obtained in three foot lengths at just about any hobby shop?

The model aircraft hobbyists use this material for the construction of landing gear struts. Any hobby store that deals in model aircraft supplies will have plenty in stock.

When cut into 19 inch lengths, this good stuff makes excellent two meter whips at a very reasonable cost. ■

Tom Yocom WA1RTD
21 Bayberry Road
Acton MA 01720

An Autopatch Busy Signal

-- when the phone's already in use

While many repeaters are located at choice mountaintop locations, others are in more convenient locations such as the home of the "highest ham in town." If the repeater has an autopatch, then the desire to use the telephone line that services the house is very strong – not only is it easily accessible but it also saves the repeater users from having to rent a separate telephone line. There are, however, two disadvantages:

1. There is a fundamental contention problem, namely that when the occupant is using the phone, it isn't available to the autopatch users and vice versa.
2. If special provisions aren't made, a potential autopatch user will attach to the phone line when it is already in use by the occupant and cause an interruption. The interruption is generally followed by the occupant having to explain to the telephone party what the "funny tones" were all about.

The contention problem and related need to share the phone line is the price you pay for not renting a separate line for the exclusive use of the autopatch circuitry. The interruption problem, however, can be solved by incorporating a circuit in the autopatch to lock out access to the phone line when it is already in use by the occupant. The fundamental characteristics of such a circuit are shown in Fig. 1. The general idea is to implement the following logic: "*If* the phone is in use *then* connect a busy signal generator *else* connect the phone line." The actual circuit isn't quite that simple, because if the phone is not in use and you connect the autopatch, then it is in use. The circuit must thus be able to differentiate between the occupant's use of the phone line and the autopatch's use of the line, so that it doesn't cycle between connecting and then immediately disconnecting the patch.

Fig. 2 provides additional circuit details. When the telephone line is not in use, the voltage between the red and green wires is approximately 48 volts dc. When the phone is off the hook, the voltage drops to about 6 volts. It is therefore possible to monitor the voltage across the line to determine whether or not the phone is in use (off hook). Resistors R1, R2 and R3 form a voltage divider circuit. When the line is not in use, the voltage across R2 is approximately 1.5 volts. This voltage is used to provide base current for Q1 through a 3900 Ohm base resistor. Thus Q1 and its associated relay RL2 are turned on when the

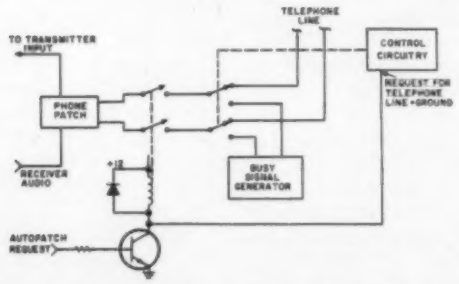

Fig. 1. Block diagram of telephone line status indicator.

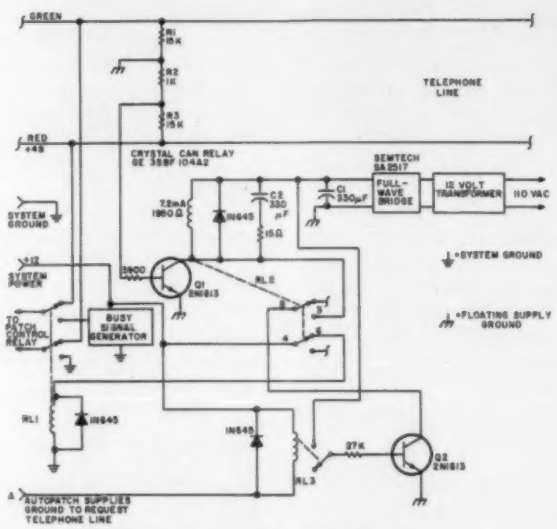

Fig. 2. Circuit diagram of status indicator.

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phone line is not in use. Note that the power supply for RL2 is a "floating supply" to prevent either of the phone lines from being referenced to absolute ground. A small filament transformer is used to provide ac to a full wave bridge and an associated filter capacitor C1 to form the floating supply. Relay RL1 connects the phone patch to either the phone line or a busy signal generator. A request for the phone line comes in the form of a ground signal at input "A". This ground signal causes relay RL3 to operate, which in turn provides base drive for Q2 (the relay isolates the system ground signal from the floating supply ground). If the phone line is not in use, contact points 8 and 3 on RL2 will be closed and Q2 will then in turn hold RL2 on even when Q1 turns off. The capacitor C2 across the coil of RL2 is provided to extend the dropout time of RL2 so that RL3 has time to operate and turn Q2 on to latch RL2.

Capacitor C2, while provided primarily to inhibit the dropout of RL2 when the patch is connected to the phone line, provides another benefit. If the phone line is in use when requested, the autopatch user hears the busy signal. If he chooses to wait for the line to be free, when the local phone user hangs up the phone, RL2 will pull in (delayed by C2) and attach the phone line in place of the busy signal tone generator. If C2 is large enough, the delayed pull-in will allow adequate time for the central office relays to reset and then provide dial tone for the autopatch user. The patch user is therefore able to wait and in turn access the phone line without having to drop the patch and pick it up again.

If a request for the phone line is received when the line is already in use, Q2 will have no effect since contact points 8 and 3 on RL2 will be open. When the phone is in use, RL2 drops out and contact points 4 and 6 are closed causing RL1 to pick up and connect the busy signal generator, rather than the phone line, to the autopatch circuitry.

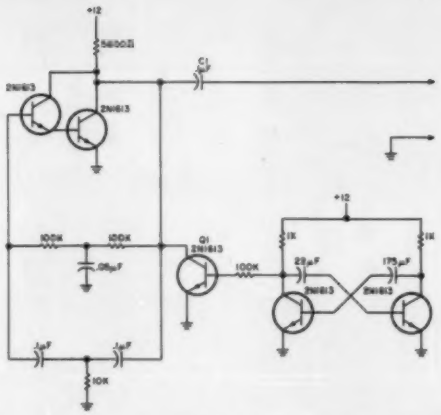

Fig. 3. Details of busy signal oscillator and switching.

The busy signal is provided by turning a Twin-Tee oscillator on and off with a low frequency non-symmetrical square wave. Fig. 3 illustrates the specific circuit used. The Twin-Tee is to the left and the multivibrator that generates the square wave is to the right. Transistor Q1 is the switch that turns the oscillator on and off. The value of the output coupling capacitor C1 can be chosen to adjust the output to a suitable level for the patch.

If the occupant is your wife, you'll find this circuit quite a blessing, for it also works like a filter to eliminate a large amount of QRM! ■

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5521 Big Oak Drive
San Jose CA 95129

Catch Standing Waves

-- with a tunable trap

I'd like to describe the construction and measured performance of a simple but effective means to eliminate feedline-antenna interaction.

The device, a T^2LT, or tunable-transmission-line-trap, is a resonant L-C circuit that is connected, between the feedline and the antenna, at the antenna. This resonant circuit is made from the feedline itself; the coil is made from a length of the feedline wound about a cylinder, with the capacitor connected across the extremities of this coil. See Figs. 1, 2(a).

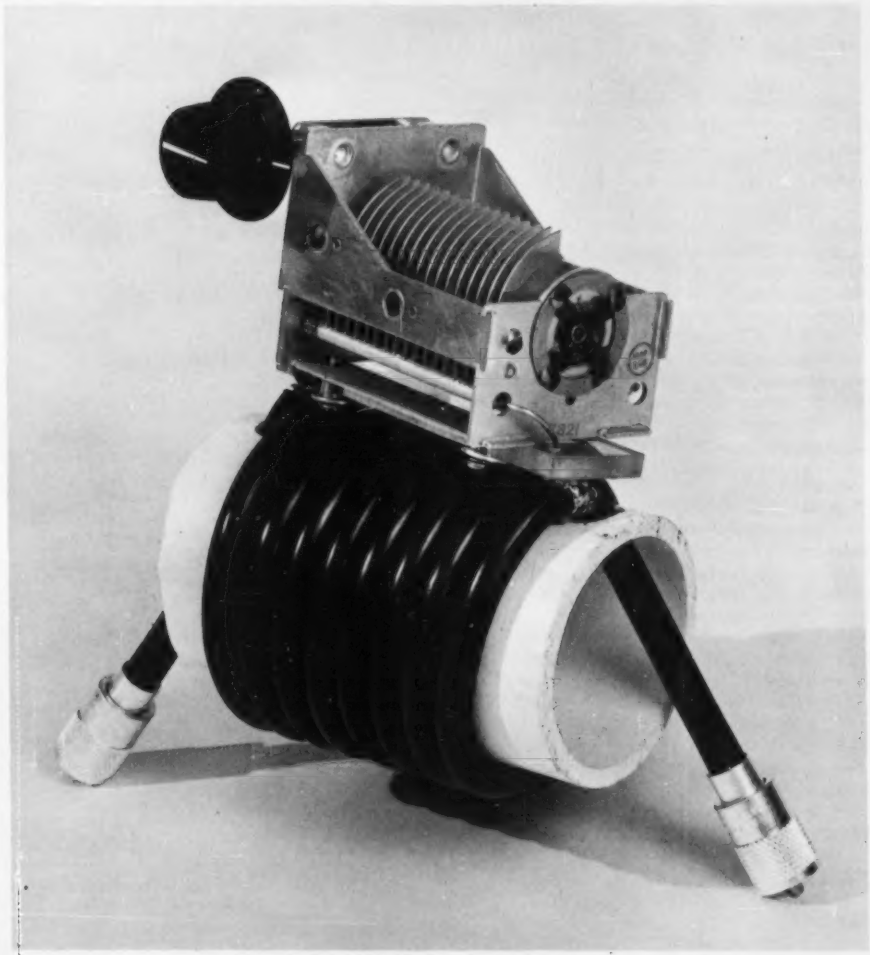

Fig. 1. The T^2LT.

The coil is wound on a length of 2½" PVC water pipe. The PVC is transparent to rf at this or even higher frequencies (still cold after a ten minute "cook" in a radar range). The coax is RG-8U, and the variable capacitor is a surplus ARC-5 transmitter unit. This capacitor has a built-in 96:1 gearbox. The coil, made of the coax shield, has an inductance of 3.4 H.

Since the coil-capacitor combination is made of, and located on, the shield conductor of the antenna feedline, its presence cannot affect the transmission line currents that exist inside the coaxial feedline. However, when resonated, this L-C circuit acts as a trap, preventing the flow of current over the shield of the coaxial transmission line.

Current flowing on the shield of a transmission line implies that the transmission line radiates energy in just the same manner as an antenna. When a transmission line, with current on its shield, is used to feed an antenna, the radiated fields of the antenna and the transmission line interact, and marked changes in the radiation pattern of the antenna-feedline system can occur. Current flowing on the feedline shield does not necessarily imply loss, but just a redistribution of the total input power into that radiated by the antenna and that radiated by the feedline. This redistribution of power can drastically affect the horizontal and vertical radiation patterns.

Fig. 3 shows the measured, field strength performance of this antenna, with and without the T^2LT. Note the increased field strength associated with the T^2LT and its sensitivity to very small changes in the resonating capacitor, indicating a high Q resonant circuit and a very

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- **FULL DIGITAL READOUT:** Six easy to read LED digits provide direct frequency readout assuring accurate and simple selection of operating frequency.
- **AIRCRAFT TYPE FREQUENCY SELECTOR:** Large and small coaxially mounted knobs select 100KHz and 10KHz steps respectively. Switches click-stopped with a home position facilitate frequency changing without need to view LED'S while driving and provides the sightless amateur with full Braille dial as standard equipment.
- **FULL AUTOMATIC TUNING OF RECEIVER FRONT END:** DC output of PLL fed to varactor diodes in all front end R-F tuned circuits provides full sensitivity and optimum intermodulation rejection over the entire band. **No other amateur unit at any price** has this feature which is found in only the most sophisticated and expensive aircraft and commercial transceivers.
- **TRUE FM:** Not phase modulation — for superb emphasized hi-fi audio quality second to none.
- **FULLY REGULATED INTEGRAL POWER SUPPLIES:** Operating voltage for all circuits, i.e., 12v, 9v and 5v have independently regulated supplies. 12v regulator effective in keeping engine alternator noises out and protects final transistor from overload.
- **MONITOR LAMPS:** 2 LED'S on front panel indicate (1) incoming signal-channel busy, and (2) un-lock condition of phase locked loop.
- **DUPLEX FREQUENCY OFFSET:** 600KHz **plus** or **minus**, 5KHz steps. Plus simplex, any frequency.
- **MODULAR COMMERCIAL GRADE CONSTRUCTION:** 6 unitized modules eliminate stray coupling and facilitate ease of maintenance.
- **ACCESSORY SOCKET:** Fully wired for touch-tone, phone patch, and other accessories.
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- **PRIORITY CHANNEL:** Instant selection by front panel switch. Diode matrix may be owner re-programmed to any frequency (146.52 provided).
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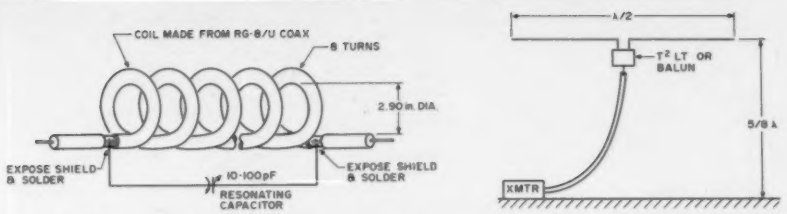

Fig. 2. (a) Schematic representation of T²LT. (b) Elevation view of antenna.

effective trap. Fig. 3 also shows the field strength level for the antenna operated without the T²LT; the reduction in field strength at the measuring point is obvious. Some of the data points were repeated with a conventional balun[1] installed at the antenna feedpoint between the antenna and the transmission line on the T²LT. It is apparent that the presence or absence of this transformer-type balun had little effect on the radiation characteristics of the antenna-feedline system. Because the T²LT forbids current flow on the coax shield, it also can be used as an effective, ground independent, means for a 1:1 transformation from a balanced to an unbalanced transmission line.

The data presented in this article can represent only the performance of this particular configuration. However, the implications are clear: The T²LT introduces essentially no loss into the feedline system, and it forbids current from flowing on the feedline shield (which must eliminate antenna-feedline interaction) and thereby allows the antenna to perform correctly.

The T²LT is simple to build and install. Build it, install it, and try it. If you find, as you tune the T²LT through resonance, *any* changes in resonant frequency measured at the transmitter, swr, loading, dial settings of the transmitter, maximum forward power, field strength, and so forth – any change at all – then you need a T²LT, because the T²LT can make changes *if* and *only if* there are antenna currents on the feedline. ■

References

[1] *The Radio Amateur's Handbook*, 1975 Edition, Fig. 20-16, A, p. 581.

[2] *Ibid.*, Fig. 17-46, p. 532.

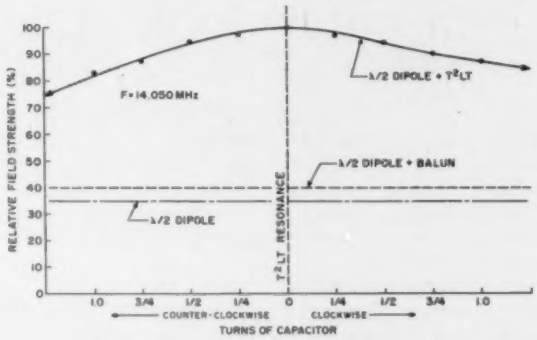

Fig. 3. Relative field strength versus capacitor turns (field strength measured at 10λ, broadside).

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Inside the GLB

- - a gutsy look at a synthesizer

The use of synthesizers instead of crystals is getting to be quite popular by 2 meter operators. It makes good sense to use such a device for the serious operator, since in the long run it is much cheaper to have this gadget instead of a handful of crystals. In a busy area most 2 meter transceivers won't take all the crystals you want it to due to the limitation imposed by the channel switch.

The GLB Channelizer has attracted considerable interest by many people. The firm runs a small ad in *QST* which is easy to miss and doesn't say much. On writing for the literature, one learns little more than the ad says, getting a price list without much supplementary information. An equipment review appeared in *QST* some time ago which described the unit in glowing terms, but who has seen an equipment review that has spoken of the item in pejorative terms? The GLB is a good unit, but it is not without its drawbacks and problems. I saw one in use at WA6FKM and found it to be most useful and efficient, so I bought one and it is pretty much living up to its expectations.

Much in GLB's favor is their speedy delivery service. The unit arrived in just over a week after it was ordered. There was a small shortage in the resistors with some of the needed ones missing and some extra ones enclosed, but the company promptly supplied the missing components. The problem in supply was the receive offset crystal — it took just over six weeks for the offset crystal to arrive which was a rather frustrating experience. I had the unit assembled except for the crystal, so the equipment rested on my desk, then in a box, mostly assembled, for this time. Of course, ordering crystals from the manufacturers often incurs such a delay. Bernie Sanders of GLB advised me by letter when I inquired when I could expect the crystal,

> "... any business is facing [problems] today with regards to obtaining any kind of mfg. component. We order, get a delivery date, and then keep calling our vendors who are late as much as 6 to 8 weeks."

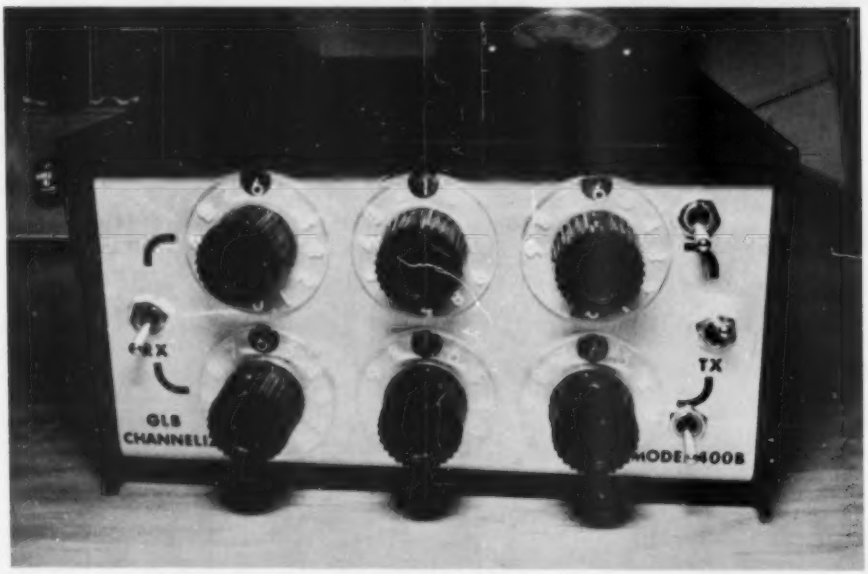
I was quite pleased with how helpful they were when he advised me:

> "You can always get a xtal from some other manufacturer and we will refund the amount you pay for it ... There are very few vendors that can make a .0005% xtal these days."

Considering that I would have to wait as long as they for anything, I maintained my patience and the crystal did arrive.

Alignment of the instrument is quite simple with clear information in the instruction book for use with a frequency counter or with a communications receiver tuned to WWV. Since WA6FKM had experience with the unit and a good counter, I dropped by one Sunday afternoon to get the Channelizer calibrated.

Constructing the unit is not without an occasional problem. In one or two places it is not absolutely clear just what is to be done, but a quick check with the diagram will explain the problem. In one place one must construct a coil on the supplied coil form with the supplied #32 wire. This is enameled wire which should have the enamel scraped away where the wire will be soldered. The instructions say nothing about



Front view of the GLB Channelizer.

73 magazine

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The subscription rate for 73 goes up January 1st – Happy New Year! What will 73 cost you next year? Dearly . . . $2 a copy at your dealer. That's $24 for a year . . . more than a dinner for two in most restaurants.

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In addition to saving $12 right off the top (it'll buy a few crystals), you'll be sure of getting every issue of 73 and keeping your library intact. You never know when you are going to need a back issue. In a few months this stuff about microcomputers may get to you and you'll go crazy trying to find a missing issue.

If you are trying to decide between 73 and some other ham rag, consider this: 73 has more articles, more pages, more ads, and 73 tells it like it is. You just get a lot more with 73. The higher pay for articles gives 73 first choice of writers. Is 73 really bigger or is that baloney? Look at the numbers – the last six months of the magazines stacked up like this: 1168 pages for 73, 964-752-500 for the other three.

What about ads? If you want to know what is available at the best prices, you want plenty of ads – particularly when the magazine keeps out the crooks. 73 ran 520 pages of ads in the last six issues vs. 434-369-135 for the other three.

One thing you won't get any place else: the other side of the coin as far as the ARRL is concerned. 73 tries to bring you a rounded picture of what is actually going on, without pulling punches.

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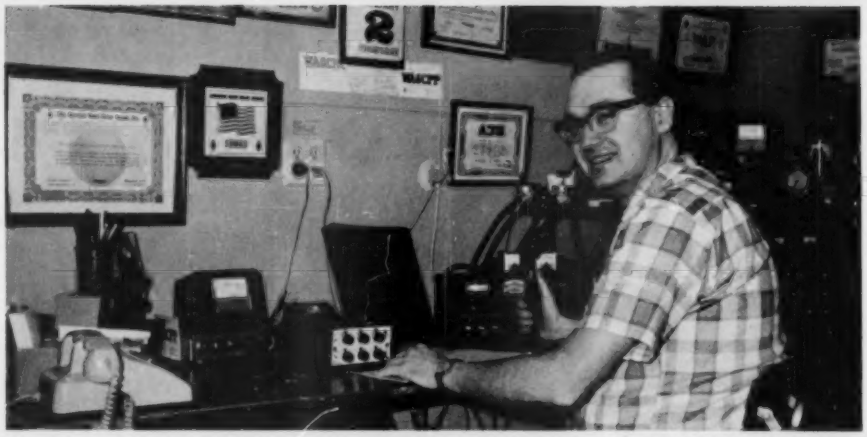
scraping the enamel; an inexperienced builder might not know about this. Location of parts on the supplementary frequency doubler board are not indicated on the board, nor is it easy to make determination from the instruction sheet. It isn't impossible but it takes some studying.

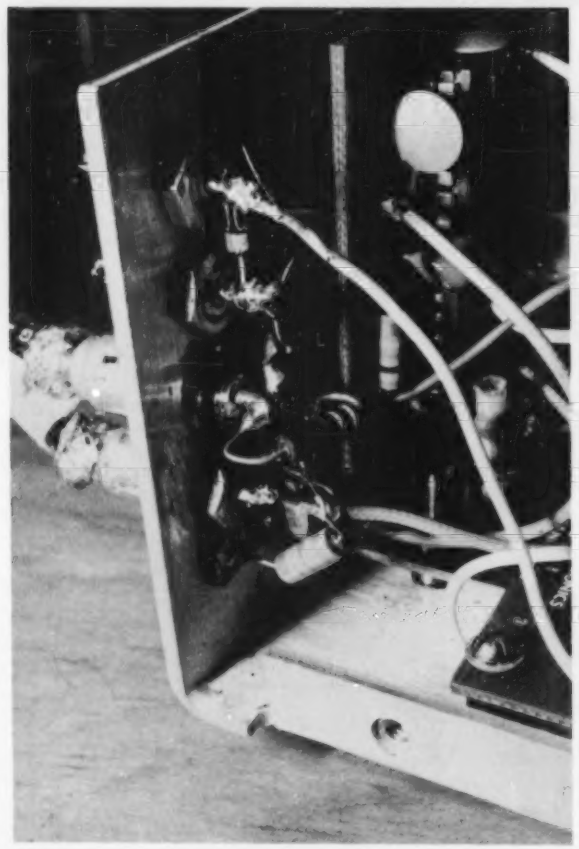
No sockets are provided for the transistors – I would have preferred this (I could have purchased some) since I am always afraid of damaging these items when soldering. Sockets are provided for the integrated circuits.

The unit uses these RCA-type pin plugs for the rf outputs; I would have preferred to use a more sophisticated rf connector. Of course, I could have done something about this, but I didn't.

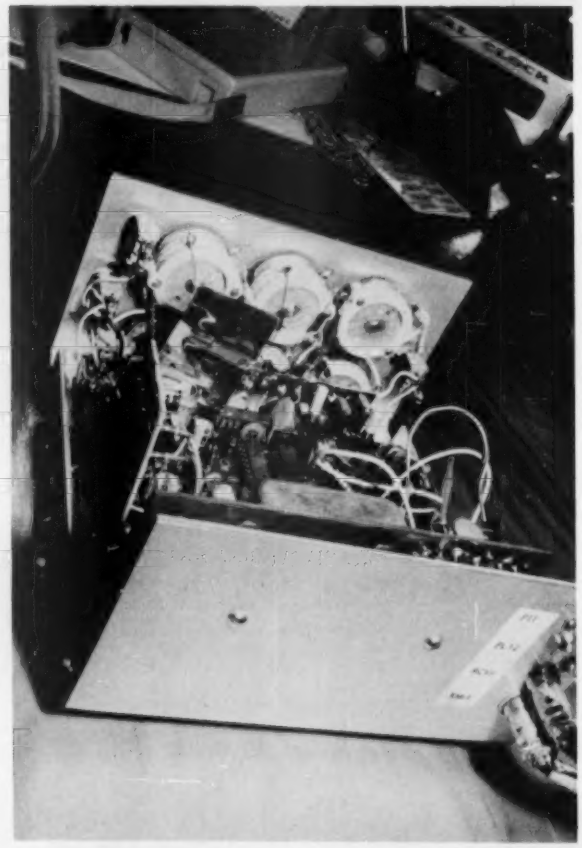
My friend had two problems with his unit – he thought the power transistor was running a bit warm, solvable by using a larger heat sink; and the unit would get out of lock, causing all sorts of problems, solved by interchanging two of the ICs.



My unit had some interface problems with my Regency HR2B. It worked fine between 144 MHz and 146 MHz, but in the 147 range the output dropped off to less than one Watt on the high power (15 Watt) position. The voltage in the Regency circuit was less than that obtained with use of a 147.54 crystal. However, the output voltage from the Channelizer was constant. This problem was solved by disconnecting the output filter on the transmit line – evidently the frequency of the low pass filter was too low. On the receive side there were a number of spurious responses, receiving repeater outputs in funny places, along with a couple birdies.



Inside view of connections showing the diode between +12 and PTT to absorb voltage glitches caused by rig's relay releasing and special resistor installed on output of receive frequency to pad it down a bit (3rd one down).



View from the back showing the heat sink, connections, crystals, and diode switching.

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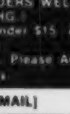

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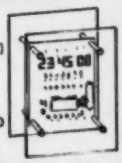

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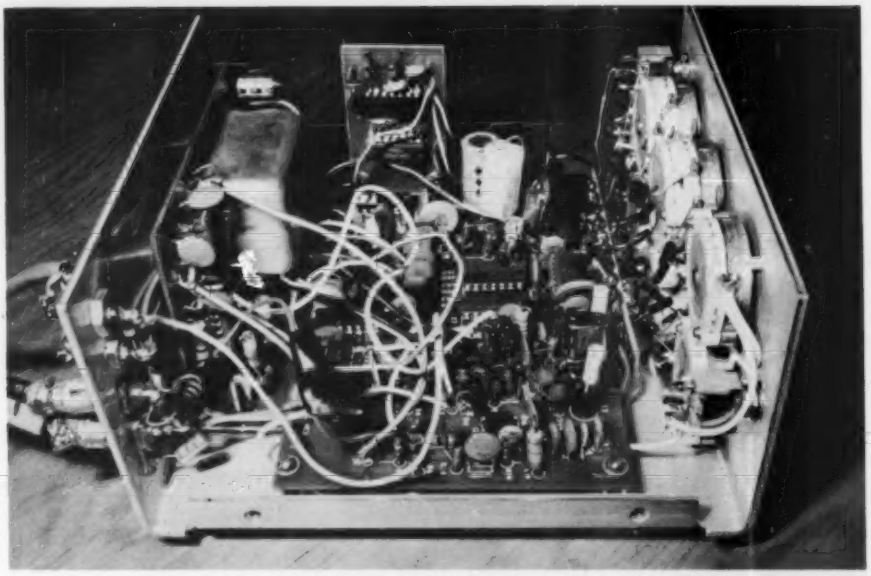


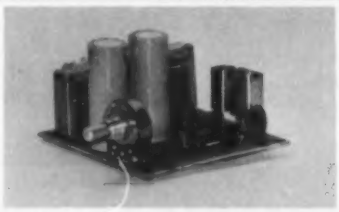
General view of inside of unit. 5 kHz board is vertical one in background with the two ICs. Top board mounted on the back is the VCO board with the shield over the critical components. Below this is the frequency doubler board (almost out of sight, it has the 2 coils mounted on it).

This problem was solved by inserting a 470 Ohm resistor in series with the receiver output. Apparently the signal injection was at a bit too high level and caused this problem.

These were the only things on the negative side. On the positive side, the unit is ultra stable, quite versatile, simple and functional. It is nice to be able to use the entire 2 meter band, even with 5 kHz steps, rather than be restricted to 12 channels. (After all, one wouldn't get on 20 meters and use only a few frequencies!) The unit will also function as a rough frequency checker — it is quite easy to tell if the other person is on or near the proper frequency by moving in 5 kHz steps and noting the fuzziness of the response. At the same time, your station can move up and down in 5 kHz increments and he can check his bandwidth or whatever.

The GLB people are most helpful in their correspondence and over the telephone. I would honestly recommend this unit to the serious 2 meter operator, with the provision that anyone should be prepared for the delays, which aren't really GLB's problem, and the minor construction difficulties, which would creep up in almost anything. Once it works, it works just great. ■

ADVA



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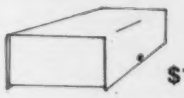

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Fig. 1.

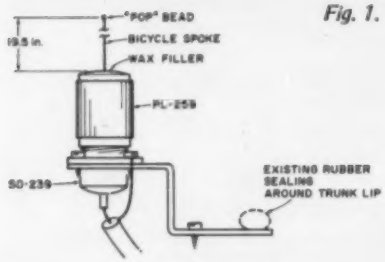
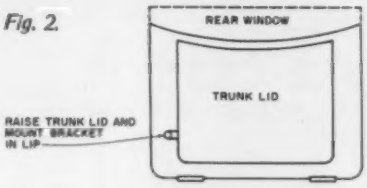


Fig. 2.



The wide array of available 2 meter mobile antennas can make it rather difficult to settle on a particular style. Often one doesn't care to invest a large sum of money in the mobile antenna because of low funds or fear of being ripped off. Thus the following three suggestions are offered, each of which can be assembled in a very short time (I built one in 10 minutes).

These antennas, when carefully assembled and properly cut to the desired frequency, will perform as well as their commercial counterparts.

Trunk Mount Antenna

First cut a bicycle spoke, welding rod or piece of bus bar approximately 21½ inches long. Fit this into the center conductor of a PL-259 rf plug and solder. Fill the connector with candle wax or epoxy and smooth off the excess. The wax will act as a sealer and insulator. The antenna length from top of connector to antenna tip should now be trimmed to your favorite frequency.

Next, a thin piece of metal approximately 1½ inches by 3 inches is bent as in Fig. 1 and painted. This will act as a mounting bracket. One end is drilled and fitted with an SO-239 rf chassis connector. The other end of the bracket is drilled to clear two sheet metal screws.

Now connect RG-58 transmission line to the SO-239, slipping the braid under a mounting screw. Mount this assembly in your trunk lid *lip*, shown in Fig. 2, using two sheet metal screws. All autos have a little extra space here, so the screws will fit nicely. These screws are covered when the trunk is closed, thus preventing leaks and displaying a neat assembly.

Finally, run the transmission line to the front of the car and connect the rig. If you need a quick portable whip, just unscrew the top section, connect it to an 831AP right angle adapter and plug it into the back of your rig. A home brew 5/8 wave antenna could also be used with this mounting system.

Gutter Clip Antenna

First, build the antenna whip assembly as described previously. Now secure an 831J double female rf connector and large, battery-type alligator clip. (The aluminum type are relatively inexpensive.) Tightly wire the 831J connector to the alligator clip and plug the whip assembly into one end.

Plug the transmission line from your rig into the other end of the 831J, and then clip the assembly on your auto's gutter. Finally, tape the transmission line in position for a few days to "train" it. Fig. 3 shows details of this super quick, but very effective, antenna.

Luggage Rack Antenna

If your auto has a luggage rack, a quick mount can be fabricated quite inexpensively.

Shop the hardware store for a U bolt which fits snugly over a *flat* bar on the rack. Mount the U bolt securely in the desired position, with the threaded ends *up*. Later you will slip a mount and a second nut on one side.

Now find a piece of metal approximately 1 inch by 3

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inches and drill a hole in each end. Mount an SO-239 connector (antenna mount) in one end and bolt the other end to one side of the U bolt on the luggage rack, as shown in Fig. 4. (If you purchase two U bolts, this piece of metal may be salvaged from one.) Now plug in the whip assembly mentioned previously, and run the transmission line inside the auto. I might add this method works beautifully with roof mount type whips like the Antenna Specialist M7A, and sure beats drilling a hole in the roof.

While the three antennas previously mentioned were designed as an inexpensive answer to 2 meter mobile applications, they also contain some unique ideas. Why not give one or two of them a try? They go together nicely and work very well. ■

James C. Nordgren WB9BNF
1100 N. LaSalle, Apt. 1106
Chicago IL 60610

Fig. 3.

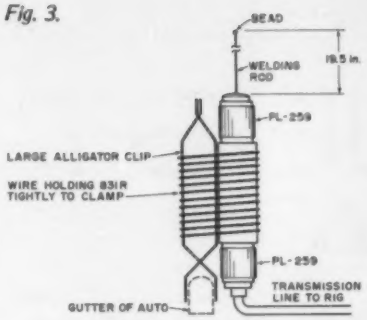
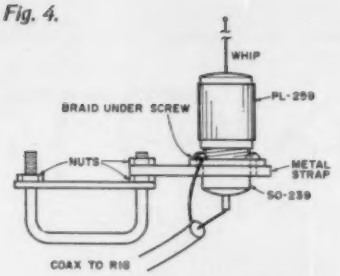


Fig. 4.



How to Bug an Automatic Keyer

- - putting new life in an old bug

After unsuccessfully trying to trade my Vibroplex semiautomatic key "bug," I decided to try to modify it to work with my new electronic keyer.

The modification takes just a few simple steps. Remove the connections to the "dit" post on the bottom of the bug and spread them out as shown in Fig. 1. Place a piece of plastic tape between the 4-40 screw and bug bottom to prevent a short circuit between "dah" connection and ground.

Next, advance the dit post screw forward, so that the vibrator always makes contact with the dit post when the paddle is pressed to the right side. See Fig. 2. The weights can then be adjusted for the desired "feel" even though their position has no effect on the dit speed, which is now controlled by the electronic keyer.

Last, connect the dit and dah connections of the keyer as shown in Fig. 2.

You now have a key to use with your automatic keyer. This key can easily be changed back into a regular bug by reversing the above procedure. ■

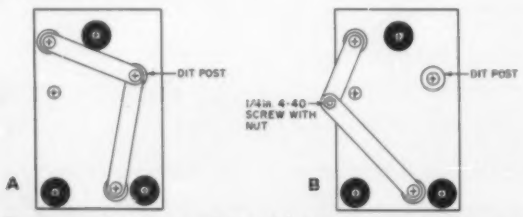


Fig. 1. Bottom view of bug (a) before modification and (b) after modification.

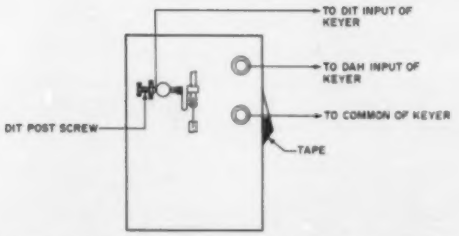


Fig. 2. Partial top view of bug showing keyer connections.

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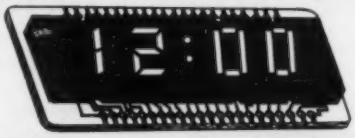

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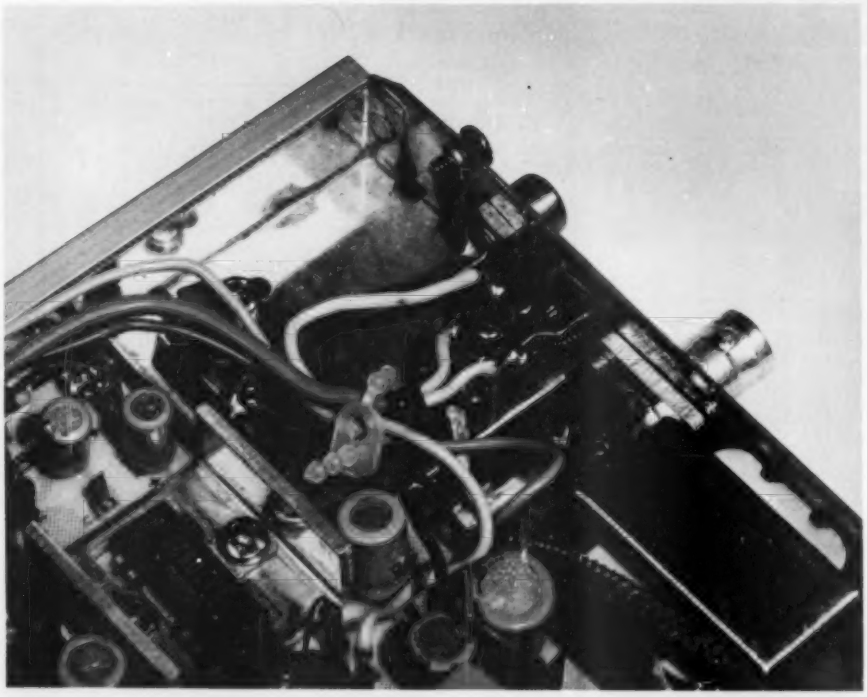
I have owned an SBE SB-450 for almost a year now and like the radio pretty well. I have never had any problems and it operates quite well, but, like many members of the ham community, I can't leave well enough alone. I wanted a full duplex radio on 450 as well as the size and convenience of the SB-450, so naturally I attacked the problem of duplexing it.

Duplexing *any* radio takes two basic steps no matter how complex the actual operation gets. They are: Fix the receiver so it has power all the time, even when transmitting, and fix the receiver shielding up so that the transmitter doesn't desense the receiver. Oh, yes, I should have said three, because you also have to add a separate antenna connection for the receiver. Digging out the SBE manual yielded a good schematic and also PC board layouts.



Rear view of the added BNC antenna connector. Although it cannot be seen here, the outer shield of the coax is soldered to the shell of the connector.

Receiver dc

Receiver dc is supplied through a regulator which is turned off by the PTT switch. After much looking back and forth between the radio and the manual, I discovered that I could remove an orange wire from point A on the R-2 circuit board and that would eliminate the PTT connection. Since this was a push-on connector, I put some heat shrink tubing over it and left it lying loose. Nothing is ever as easy as it first seems. When I tried the receiver, I still had no audio from the speaker when transmitting. Further tracing showed that the audio input to the audio amplifier

was shorted by the PTT line during transmit. That problem was easily eliminated by removing a purple wire from point H on the R-2 board and covering the end in the same way I did for the orange wire. Now the receiver was operating and audio was coming out while the PTT switch was closed.

Receiver Antenna

There is a place in the back of the radio, on the top, between the transformer and the power plug, where a BNC connector can be installed. I installed a connector and, being lazy, simply cut the receiver antenna coax where it ran past the connector, and soldered it to the new connector with the existing coax.

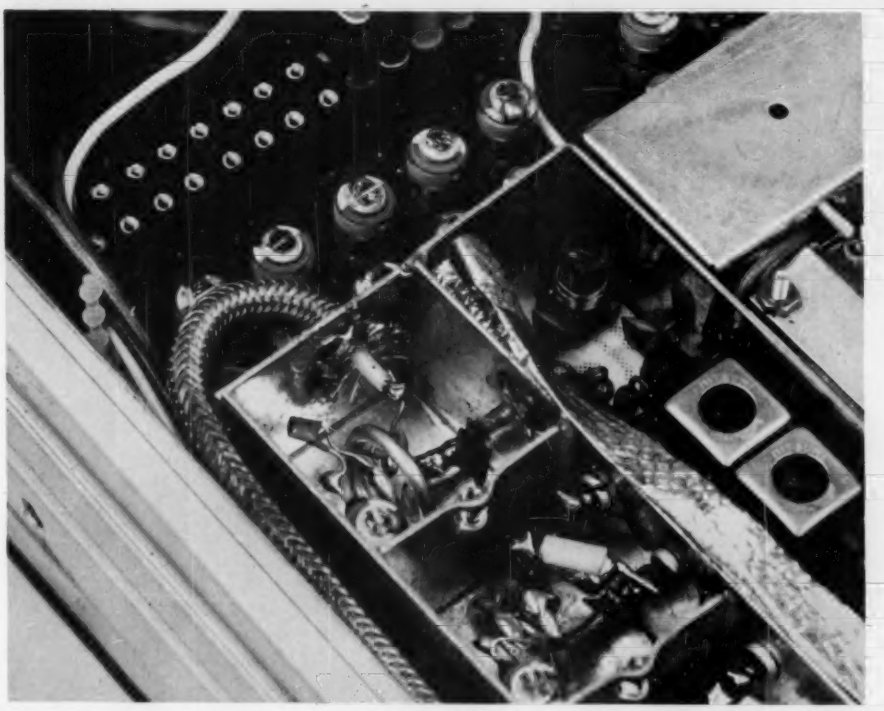
Well, I figured I was ready to test it out. I hooked the transmitter to a dummy load, the receiver to my signal generator, and powered up. The receiver looked OK and still checked out at about 0.5 uV. When I keyed up the transmitter, however, all I got was noise. I started cranking up the output of the signal generator but I couldn't get a signal through until I got above one millivolt. Gloom and despair!

Receiver Desensitization

After almost a day of zero success trying to reduce the desense with copper tape and bypassing, I called a friend who works in the EMI (Electromagnetic Interference) field. He suggested I make sure the antenna input was properly shielded, and preferably double shielded. With his advice in mind, I went back to the rig.

The antenna connection leading into the rf section on the receiver is nothing but an unshielded feedthrough with the coax connected on the outside and a coupling capacitor on the inside. The neatest approach would be to put a coax connector (miniature) on the rf section, but the crystal trimmers prevented that. A couple of cups of

Front right view of the transceiver with the top cover removed, showing the receive coax cable entry into the rf compartment. Note that the outer braid is soldered to the outer wall of the compartment.



Inside of rf shield in the top of the radio. The receive coax cable with its inner shield is coming through the hole left by removal of the original feedthrough. Depending on the size cable you use, you may have to enlarge the original hole. The inner braid is soldered to the inside of the compartment. The center conductor of the coax is then soldered to the small coupling capacitor originally connected to the feedthrough. Copper tape can be seen folded back along the right side of the shield compartment.

coffee and a few swear words later, I decided to replace the entire receiver antenna connection.

The first thing I did was remove the existing coax and the antenna feedthrough. (That takes a heavy duty soldering iron.) Then, not having double shielded coax, I took some better quality regular 50 Ohm coax, stripped it, and fed the shield and inner conductor through the hole left by the feedthrough. I soldered the inner braid to the inside wall of the rf section housing, and the inner conductor to the capacitor lead previously removed from the feedthrough. Then I slipped a piece of braid taken from another coax cable over the outside of the new cable and soldered it to the outside of the rf section housing.

The problem of maintaining shield integrity to the chassis was solved by removing the threaded chassis BNC connector that I had put in earlier, and replacing it with one having a shielded back. This all sounds much easier than it actually was. In order to install the flange mount BNC connector, I had to remove the mounting screws from a transformer and move it aside until the connector was in place. Then I could only get one screw back into the transformer mount. I routed the coax, closed up the receiver section, and added some copper tape. I haven't taken measurements to see if the tape is necessary.

Conclusion

Well, to end a long story, it worked. I still have a very small amount of desense, but all in all, it works very well and the appearance of the radio is virtually unchanged. Additionally, it would only take a few moments to convert the radio back to simplex operation. I'm even happier with the radio now than I was before it underwent surgery. ■

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Turn Signal Reminder

- - setting things straight

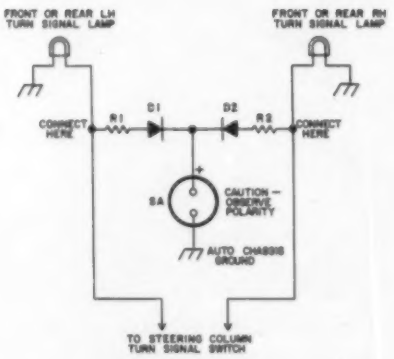

Fig. 1. R1, R2: 2.7kΩ, ½ W ±10%. D1, D2: any general purpose small current silicon diode. SA: Sonalert, Mallory catalogue number SC1.5.

How many times have you followed drivers, going down the road with their turn signals on, who don't turn? Perhaps this has happened to you on occasion? Sometimes, when making less than right angle turns, the turn signal canceling mechanism fails to function and causes this condition.

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Simply mount the Sonalert at any convenient place near the driver's position; the other parts may be mounted anywhere. Silicon diodes are used because they will function better (higher reliability than germanium types) in the high heat environments encountered in automobiles.

The schematic shown is for 12 V negative ground systems. For 6 V negative ground systems change R1 and R2 to approximately ½ the resistance values. For positive ground systems reverse the diodes and the Sonalert. Less than 4 mA current (intermittent) is drawn by the Sonalert, so there is no significant loading of the automobile's electrical system.

The sound is produced by a piezoelectronic transducer, and the frequency is generated by a transistorized circuit which is an integral part of the Sonalert and cannot be altered by external means. Any attempt to alter the output frequency or volume may damage the device.

Sonalert is a registered trademark of P.R. Mallory and Company of Indianapolis IN. These units are available in radio supply stores, or they may be ordered directly from Burstein Applebee, 3199 Mercier, Kansas City MO 64111. ■

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Do-It-Yourself Ceramics

- - for tube sockets, insulators, etc.

Most of us builders have at one time or another run up against a problem with only one solution – do it yourself. Suppose someone should give us a gold nugget, a 416B tube, for a high frequency project. What are we to do for a socket? The answer is to make one. Let us then borrow an idea or so from the hobby of ceramics in much the same way we have borrowed printed circuits and silk screening from other hobbies. Most of us will find ceramics an ideal way to construct a socket for the 416B tube, as well as insulators in any shape or size.

The raw material for ceramics comes in the form of clay or as a thinner mixture called slip. The clay

can be rolled out flat using a piece of wax paper above and below and rolling it out with a rolling pin or a dead 807. This clay can be cut, squeezed, fingered, or what have you, to almost any shape. After we pat it into the desired shape, we then let it dry. The dry clay can then be drilled, sandpapered and tapped. Taps for fine threads and small size (under 3/16) do not do as good a job as the larger taps. Clay at this stage is very brittle until it is fired in a kiln to about 1800 degrees. Some shrinkage is to be expected, so whatever we build should be slightly oversized.

Using slip requires a mold made of casting plaster or of plaster of paris. The mold has two functions – it gives the desired shape to the object to be cast and also absorbs the moisture out of the slip, leaving only the clay along the inside surface of the mold. As the thickness of this clay builds up to the desired thickness for the object, the remaining slip can then be poured out. This will leave a hollow object. When the walls of the object become leather-like, the object can then be removed from the mold. When dry, this is called greenware. It is very brittle until fired to a high degree of temperature in a kiln. Objects can also be made solid by leaving the slip in the mold and adding a little slip now and then to compensate for the moisture that the mold is removing.

To make a simple mold, the pattern is placed on a surface and clay is built up around the pattern until the clay reaches the center line of the pattern. A dam is placed around the pattern and clay. The whole works is then brushed with liquid soap, sometimes called green soap (a detergent will not work). Remove the surplus soap with a sponge that has been pre-moistened with the liquid soap. You are now ready to prepare your casting plaster. Casting plaster, or plaster of paris if casting plaster cannot be found, is mixed well with water in a large bowl. The plaster should be mixed to a consistency of pancake batter. This mixture is then poured rapidly into the mold form. It is good to tap the table with a hammer to move any trapped air bubbles to the surface. We can now have a cup of coffee as we must wait about 20 minutes before proceeding.

As the plaster sets, it will get very wet-looking; then it begins to look dry, and a good deal of heat will be radiated. Soon after the heat buildup, the mold form and the clay can be removed. At this point do not remove the pattern. A pocket knife can now be used to shave the half mold down smoothly or dress it up.

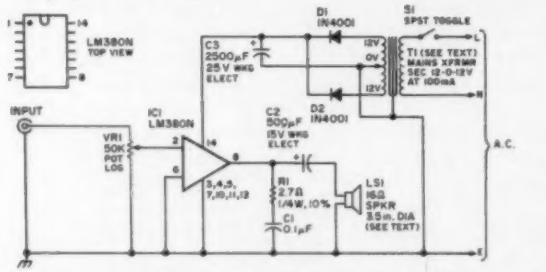
To align the two halves, dimples are now put in the part of the half mold around our pattern. Usually only 3 or 4 are enough. This is done with the tip of a spoon. The dimple is gouged out by turning the tip of a spoon in a 360 degree circle and applying pressure down. The half mold is now ready to be dammed up and brushed with soap as before. A good job of soaping is required to insure the separation of the two halves of the mold. Mix and pour the plaster as before. Another cup of coffee, or maybe two, and then the heat should be pretty well up. The dam, or form, can now be removed. A knife is used to trim the outside of the mold. Cut the corners at a 45 degree angle to prevent chipping of the finished mold. If any plaster got past the form to the first half of the mold, now is the time to trim it off. After too much coffee already, let us just wait for 15 or 20 minutes. The two halves of the mold should then be ready to separate. The two halves should come apart easily by just tapping the mold lightly on all sides and pulling gently apart. Barring any undercuts, the pattern can now be removed. Trim

out a funnel-shaped hole, half on each mold section for a pouring spout. The mold will be finished when it is thoroughly dry.

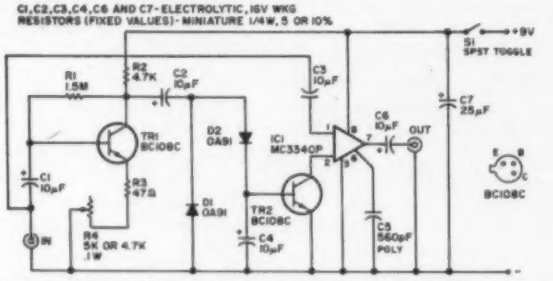
The two pieces are joined together while in a leather-like state. An ordinary art brush is used to brush fresh slip on the parts to be joined and then they are put together.

To make sockets for the aforementioned 416B, find a 7 or 9 pin ceramic socket and observe how the pins are mounted. Then create a socket for the 416B constructing it along the same lines as the 7 or 9 pin socket. (Pins can be removed from the sockets.) Some of the sockets we made here had tie points added. The tie points were constructed by adding a standoff to the sockets and drilling small holes around the top. Such use of ceramics need not be limited to the 416B or coil forms, of course, but may also be used for many other projects.■

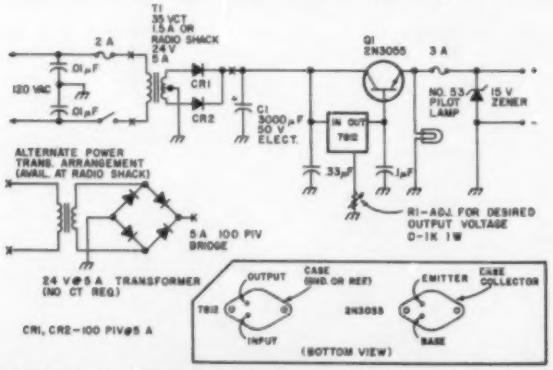
Circuits[2]



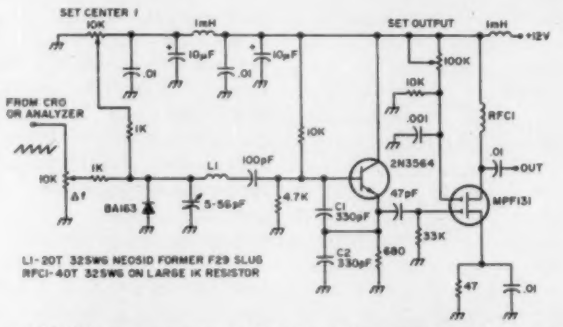
A general purpose amplifier using a few simple parts. Reprinted from Radio & Electronics Constructor, *July, 1976.*



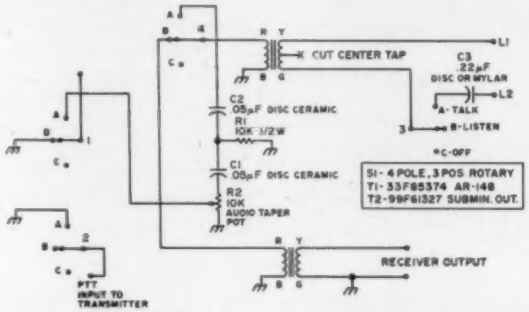
Simple audio squelch unit which suppresses all input signals below a preset threshold. Reprinted from Radio & Electronics Constructor, *July, 1976.*



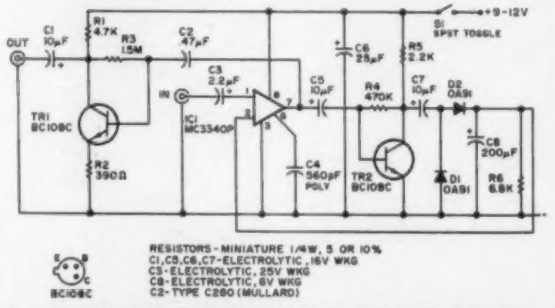
A $10 12-14 V regulated 3 A power supply. Reprinted from The State of the Arts, *August, 1976.*



A 10.7 MHz sweep generator for looking at the response of an i-f amp or a filter. Can be used with an oscilloscope or, for more dynamic range, with a spectrum analyzer. Reprinted from Amateur Radio, *May, 1976.*



A poor ham's phone patch. L1 and L2 are the red and green wires of your phone line. Reprinted from the Hall of Science Radio Club Bulletin, *September, 1976.*



An audio compressor. If the input signal is kept above the threshold level, output will remain constant. Reprinted from Radio & Electronics Constructor, *July, 1976.*

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Tubes...?

-- VFO project for nostalgia buffs

The crystal-controlled oscillator just won't cut it for today's operating practices. You just have to possess the ability to move around in a band if you want to make contacts. And you do want to make contacts. That puts the would-be builder in a tough spot. It's easy to put together a crystal-controlled rig that'll produce a clean signal, one that's a compliment to its builder. But getting such a signal from a variable-frequency oscillator is quite another matter!

This article concerns building a self-excited oscillator. It's written for the radio amateur who has wanted to build a transmitter but has hesitated because of the known difficulty of making a VFO that sounds right. The second purpose of this article is to encourage prospective builders to use parts that may be at hand or that can be mooched from some other amateur's junk box. Therefore, I'll talk a bit about some design considerations.

If you're not an experienced and highly-talented builder, it's best to start with a single-band rig. Its simplicity helps much to avoid the pitfalls that await the builder of a multi-band rig.

Decide what band holds your greatest interest. Consider such factors as antenna requirements, band activity at the time of day and season you operate, and that harsh truth of oscillators being more difficult to build as frequency goes up. Many builders conclude that the 7 MHz band represents a reasonable compromise among the many (and sometimes conflicting) considerations. We'll talk about an oscillator for that band. Unless you're firmly dedicated to "state of the art" solid state techniques, it's recommended that you use vacuum tubes for your first building projects. There are many and quite sound reasons. Vacuum tubes abound in junk boxes. Those from old TV receivers and military surplus radio or radar sets lend themselves to amateur projects nicely. Then, too, I've found it's just one heck of a lot easier to get a decent note out of a vacuum tube than from a transistor.

The next decision concerns the oscillator circuit to be used. Just about any can be made to work well. Some can be coaxed to give a good note more easily than others. I've tried just about every one that's shown up in amateur radio publications over the past half-century, and have found one that seems just a bit more nearly "foolproof" than others. Note, though, that this is purely a personal choice and does not imply that other persons may not find another circuit more to their liking.

Why did I select this one circuit from among many? Because it offers easy means of adjusting the feedback to just the precise amount needed to ensure stable oscillation and yet deliver a note that's free from the harshness characteristic of an oscillator being "pushed" too strongly. Its schematic diagram appears in Fig. 1.

A prototype was built up to check its operation. "Built" is too strong a word. Rather, components were tacked together by their leads. Then the values of certain components were "diddled" to discover just what it took to make the note clean. Many will affect the note. The grid capacitor C1 has little effect upon the note, but does have a bearing upon the effect of tube capacitances upon the frequency-determining "tank." The output coupling capacitor C4, being in a low-impedance portion of the circuit, has only a minor effect upon its oscillation. The value of R2, the cathode bias resistor, does affect oscillation. It, however, should be of a value selected to place the tube's quiescent operating point at about the midpoint of the straight portion of its $E_c I_b$ curve. (Read that as saying the tube should be biased as though you were using it in a Class A amplifier circuit.) That leaves two parts, R4 and C2, that strongly affect feedback and which can be safely altered.

Roughly speaking, C2 should be as small as you can make it and still have reliable oscillation. Its value will vary depending upon many factors, such as tube type, value of R4, plate voltage, etc.

There's no reason why you can't vary R4 over whatever range it takes to give an acceptable note. I'm assuming, of course, that you're listening to the oscillator on a receiver with its antenna disconnected, so as to prevent signal overloading.

Now, let's talk about tubes. Almost any dual triode or even two discrete triodes with their cathodes strapped together can be used. There's little choice. I used a 6J6 just because I had a potful on hand.

Perhaps the matter of second importance in an oscillator is that of short-term frequency stability, that of not creeping during a transmission. Rigid long-term stability can be a hairy problem, but short-term stability usually can be achieved by mounting components solidly. It helps, too, if the resonant circuit has high Q. Fortunately, there's a simultaneous solution to these two problems: Use a ferrite-core toroid coil for the inductor. This type of coil

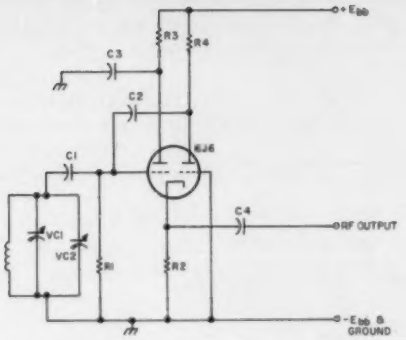

Fig. 1. Basic oscillator circuit. In this circuit, feedback is through C2, encouraged by R4. C3 and R3 serve only to ensure having the plate of the first triode at ground potential. The second triode acts as a grounded grid non-inverting amplifier. Low impedance rf output is taken from across the common cathode bias resistor.

can be mounted solidly, and, with the proper kind of core material, the Q can be high indeed. But be sure you use a core material known to be suited for the high frequency band! Also, it's important to use plenty of capacitance in the resonant circuit. For 7 MHz, 100 pF is not too much. If you try to get this amount in one capacitor, the rate of tuning will be too rapid, so it's best to use two variable capacitors, one of high capacitance (about 100 pF maximum) for setting the frequency at one edge of the band, and another (much smaller) to vary the frequency over the band. Ideally, the 180° rotation of the bandspread capacitor should just cover the desired frequency range. You can compromise, though, on something far less than this ideal! But if you're a purist, you can achieve the ideal by judicious juggling of the magnitude of inductance, bandset capacitance, and bandspread capacitance.

A third matter of importance in an oscillator is that of isolating the oscillator's frequency-determining circuit from external disturbances. You can start by ensuring a stable plate voltage supply, which is easily accomplished by use of VR tubes or any of the several other means of obtaining a steady voltage source. Less easy, though, is the task of isolating it from a changing load. If that load is keyed, as it will be if the oscillator excites a radiotelegraph transmitter, the load change is abrupt and violent. So you'll need rather elaborate and highly effective isolation. The simplest way of getting that isolation is by adding Class A buffer stages.

We've talked about what can be done. Now let's talk about one way of doing the building job, not forgetting that there are innumerable other ways of arriving at the same goal just as effectively.

I told you about tacking together components to make a prototype and about experimenting to ascertain the proper values of certain parts in order to get stable operation and a pure-sounding note. The next logical step is to build up the circuit in a practical form, a configuration that'll permit it to excite another stage. It was with considerable trepidation that I approached that task, for years of experience had taught me the truth of that old adage: "If it looks like hell, it'll work swell. If it looks swell, it'll work – like hell!" Because of having been constructed entirely from parts rooted out of my junk box, the finished product certainly would take no beauty prize. Perhaps because of that, it worked quite well!

The exciter's schematic diagram is shown in Fig. 2. Although it shows 6AC7 tubes being used in the Class A isolation (buffer) stages, again let it be emphasized that there are dozens of other types of tubes that could have been used. I selected 6AC7s because I had about a gallon on hand, plus a few quarts of octal sockets. Many of the newer and hotter TV tubes probably would work even better. There's no need to be concerned about getting a tube that's too hot; the resistance coupling between stages insures unconditional stability. Just remember to use a suitable value of cathode biasing resistor and the recommended value of plate and screen grid voltages; with these precautions in mind, you can toss in just about any tube that turns up in your (or your friend's) junk box.

My exciter is built in a box measuring 3" wide, 4" high, and 5" deep. Tube sockets are mounted on the top surface, the bandset and bandspread variable capacitors on the front, and all other components within, either on socket terminals or tag strips. The toroid coil is cemented to a plastic mount which, in turn, is bolted to the inside top surface. This permits short leads to the variable capacitor and to the oscillator tube. Filament, screen grid and plate supply leads are brought out in a cable.

Only one construction feature might be thought of as unorthodox: The "cold" side of the rf output is brought back through an insulated feedthrough to the cathode of the output tube. It may not be important, but some experienced builders consider it wise not to cause rf to flow *through* a shield. The "hot" side of the rf output, of course, is brought out through another feedthrough insulator.

This rf output, which is isolated from all dc potentials, may be used to excite a larger tube. Or, you may want to run it into a pi net and couple it to an antenna. The power may seem to be insignificant, but I've worked into Hawaii with

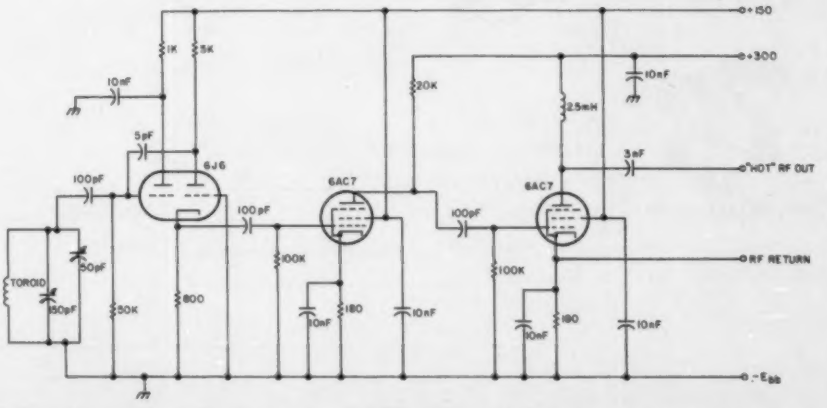

Fig. 2. VFO exciter for 7 MHz. Number of turns on toroid depends upon its physical size and electrical permeability.

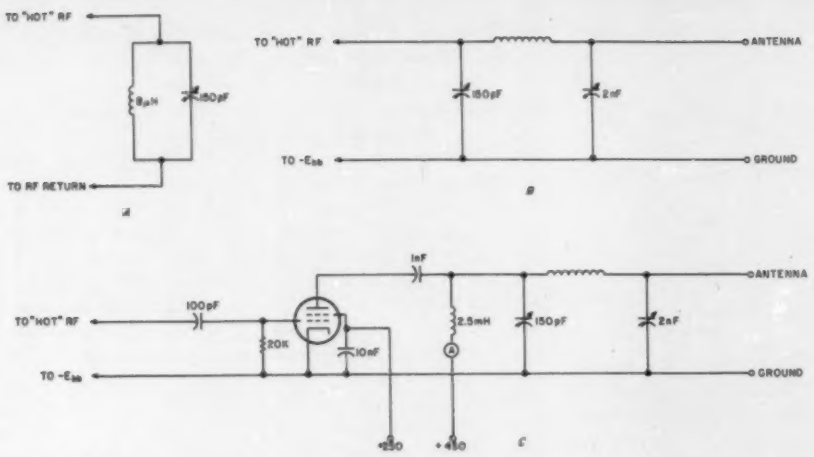

Fig. 3. a) Test termination for checking for rf output. b) Pi net for coupling to antenna; requires provision for keying. c) Rf amplifier using 807, 6146, etc.; suggest use of grid-block keying.

no greater power! An additional stage is advisable, however, if only to permit convenient keying.

You'll note that I've not mentioned power supplies other than to say that the one for the oscillator should have good voltage regulation. Most radio amateurs have power supplies on hand. If you don't, every handbook tells you how to build one.

You may have noticed that I've avoided saying much about the inductor used. Its core started life as the tuning slug in the plate tank circuit of a BC-457 HF transmitter. Many years ago I read that one could make a good core for a toroid coil from this slug by sawing off a piece, drilling a hole through it, and rounding off the sharp edges with a file. This I did. Then the core lived in a cabinet drawer until I ran across it while excavating for parts for this oscillator. I'm happy to say the long-forgotten author was quite correct!

This rambling article has been written in hope that it will encourage persons to build, using parts on hand or ones that can be mooched. It was triggered by two pleasant memories. One was the period of the early thirties, when I built many transmitters and receivers from parts salvaged from old battery-operated broadcast receivers that one could get for little or nothing. The other pleasant memory relates to the period just after the Hitler war, when one could take a few dollars to a junk dealer and come back with treasures far beyond one's (pre-war) imagination. Those were heavenly days for the builder! There're still parts remaining from WWII surplus, but when these parts are gone there'll be no more. None are being manufactured. So be wise – build now before you have to pay antique-parts prices for even the simplest components! ■

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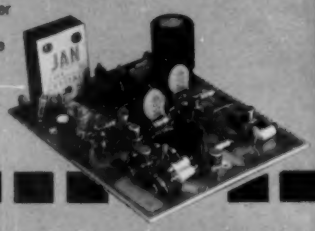

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RM-10 RESONATOR 10 METER 10.75
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RM-40S SUPER RESONATOR 40 METER .. 23.50
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RM-80S SUPER RESONATOR 28.95
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BM-1 BUMPER MOUNT STAINLESS STEEL STRAP .. 11.95
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GCM-1 RAIN GUTTER MOUNT 3/8" – 24" THREAD .. 7.50
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CDR ROTORS

HAM II ROTOR WITH CONTROL .. 139.50
CD 44 ROTOR WITH CONTROL ... 119.50
ROTOR CABLE 8 CONDUCTOR 2/18, 6/22 GAGE .. 16 FT.
RG-8/U LOW LOSS FOAM COLUMBIA SUPERFLEX COAX WITH PL-259 EACH END, 50 FEET .. 12.50
100 FEET .. 23.00
ANTENNA WIRE #17 BARE COPPERWELD STRANDED 7/25 100 FEET 3.60
PL-259 COAX CONNECTORS ..... .60
RG-8/U LOW LOSS COLUMBIA SUPERFLEX CABLE 500FT REEL 120.00
RG-58/U LOW LOSS FOAM COLUMBIA SUPERFLEX WITH PL-259 EACH END, 50 FEET .. 7.00
100 FEET .. 12.00

BARKER & WILLIAMSON

MODEL 3002W UNIVERSAL HYBRID COUPLER PHONE PATCH WITH BUILT-IN COMPREAMP. THE BEST OF PHONE PATCHES .. 125.00
MODEL 375 PROTAX ANTENNA SWITCH WITH AUTOMATIC GROUNDING, 6 POSITION REAR MOUNTED SO-239 .... 18.95
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CC-50 DIPOLE ANTENNA CENTER, WEATHER PROOFED .. 7.50
MODEL 377 ANTENNA COAXIAL CHANGEOVER RELAY, DC TO 150MHZ 115V/60HZ. SWITCHES ANTENNA FROM TRANSMIT TO RECEIVE, SO-239 CONNECTORS .. 16.50

Slep Electronics Co.

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210X 80 THRU 10M $679.00
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CRYSTAL KIT AMATEUR BANDS .. 31.20
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252G POWER SUPPLY/VOX 129.00
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ARGONAUT MODEL 509 ..... 329.00
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COMCRAFT

CST-50 VHF TWO BAND TRANSCEIVER 2 AND 1¼ METERS, DIGITAL FREQUENCY SYNTHESIS 142 TO 149.995MHZ AND 220 TO 225 MHZ 25 WATTS 869.00

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MILLEN

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SWAN

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MODEL 101, 16 CHANNEL SCANNER, 30-50MHZ 146-174MHZ, 416-512MHZ, NO CRYSTALS TO BUY 290.00
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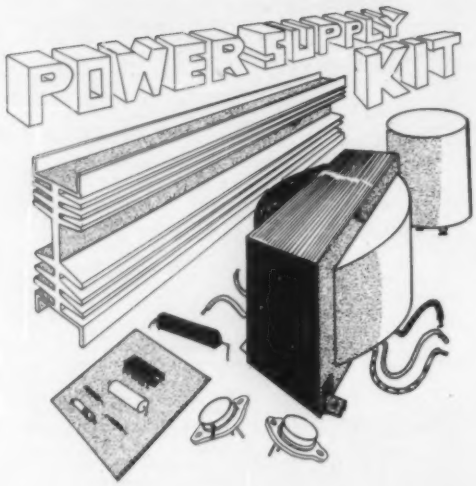
BULLET ELECTRONICS

(214)823-3240

PO BOX 19442E
DALLAS TX 75219



FEATURES:
- Output adjustable from 3 to 30 Volts DC
- Adjustable Current Limiting to 15 Amps
- Special Pre-Regulator Circuit eliminates need for massive heatsinks
- Better than 1% Load & Line Regulation from 0 to 15 Amps
- Low Ripple Output
- Heavy Duty 10 lb. transformer

KIT INCLUDES:
- Transformer
- Heatsink (drilled)
- Semiconductors (diodes, transistors, etc.)
- All Components (resistors, caps)
- Transistor mounting hardware and insulators
- Drilled & Plated P.C. Board
- Wire

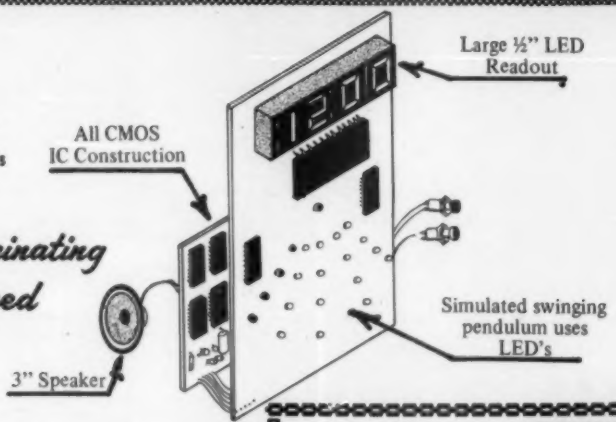
Not only is the PS–12 able to supply a continuous 15 AMPS of low ripple, regulated DC Voltage, but it is also variable from 3 to 30 volts! Use it as a building block for a fantastic bench supply. The chassis work is up to you – go fancy with meters and lights; or plain with a metal plate. Either way we get you out with a quality kit at a super low price and we guarantee your satisfaction.

PS-12 $49.95

INCLUDE 3.70 FOR SHIPPING

MINI GRANDFATHER CLOCK KIT

- 4 Digit LED Readout
- Simulated Swinging Pendulum
- Tick-Tock sound matches pendulum swing
- Electronic Tone Chimes the Hour (ie: 3 times for 3 o'clock)
- Quality Components & P.C. Boards
- Transformer for 115 VAC included.



The most novel and fascinating kit we have ever offered

$44.00

POSTPAID

NO CASE INCLUDED, LET YOUR IMAGINATION RUN WILD AND DESIGN YOUR OWN. WE SUPPLY ALL THE ELECTRONICS.

Tex. Res. add 5% tax.

NO CODS
SEND CHECK
MO, BAC, MC

Your BANKAMERICARD welcome here

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BUILD A COMPLETE CDI IGNITION KIT AT A FRACTION OF THE COST OF OTHER UNITS. A special buy allows us to sell the complete kit at this low price! Up to 40,000 volts from your present ignition without changing the coil. Simple connections.

INCLUDES: Special toroid transformer
Drilled and Plated board
Complete instructions
All resistors and caps
All semiconductors

$9.95

(Does not include heatsink or case.) For 12V negative ground systems.

PS–01 POWER SUPPLY KIT

IMAGINE! A power supply with a well filtered, regulated output in three voltages. The PS-01A has quality IC regulators, semiconductors and components. The transformer is custom designed and well made. Features 10mv load regulation.

YOU GET:
Drilled and Plated board
Complete kit of components
Heatsinks +5V @ 1.5A
Complete Instructions ±15V @ 200MA

$14.95

NOTE: +5 and ±12VDC supply is available at same price. Order PS-01/B.

MASSA AIR ULTRASONIC TRANSDUCER

TR–89

BUILD YOUR OWN ULTRASONIC MOTION DETECTOR FOR USE IN INTRUSION DETECTORS, DOOR OPENERS, OBJECT COUNTERS, ETC. WE INCLUDE COMPLETE SPECS AND RECOMMENDED CIRCUITS.

$2.49 4/9.00

TE-01 $12.00 TOUCHTONE ENCODER KIT

SINGLE IC GENERATES THE STANDARD 16 TONE PAIRS FOR TOUCH–TONE DIALING. KIT FEATURES:
Small Size (1.5 x 2.25")
NO Tuning Required
PTT Circuit has built-in 1 second delay
Low Level output is adjustable
Audio output circuit for tone monitoring or acoustic coupling
Kit includes all parts
Plug compatiblewith DIGITRAN® KEYBOARDS
Complete with PC Board

Same as above but less Audio output and PTT circuit. Smaller size permits use with handitalkies. $10.00 TE–02

MK–03 **AIRCRAFT/MOBILE CLOCK TIMER KIT**

A FULL 6 DIGIT LED READOUT CLOCK THAT GIVES 24 HOUR (ZULU) REALTIME AND ELAPSED TIME IN SECONDS, MINUTES AND HOURS UP TO 24 HOURS. READOUTS CAN BE TURNED OFF OR DIMMED PC BOARDS ARE SMALL TO FIT INSIDE A STANDARD INSTRUMENT CASE (2¼" Dia.)

FEATURES:
.3" LED Readouts
Special Noise Filter
Quality plated boards
Real Time (24 hr.)
Elapsed Time
2 MOS Chips

$26.95

12V NEG GND

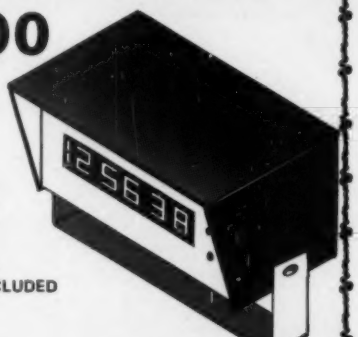
KIT IS SUPPLIED WITHOUT SWITCHES OR CASE

MOBILE CLOCK KIT

COMPLETE WITH PRE–PUNCHED CUSTOM CASE AND MOUNTING BRACKET. CASE IS HEAVY GAUGE ALUMINUM WITH A BLACK WRINKLE FINISH TOP AND WHITE FRONT.
12 HOUR FORMAT ONLY.
CLOCK HAS ALARM CAPABILITY (extra parts needed).

$25.00

COMPLETE!



MK-04

- 6 DIGIT LED
- .4" READOUT
- TIMEBASE INCLUDED

ULTRASONIC SENDER-RECEIVER KIT

A special buy on a high quality ultrasonic transducer allows us to offer this kit at a super price – but hurry, quantities are limited! You can build **intrusion alarms, motion detectors, remote controls, echo ranging or liquid level measurement equipment.** We supply the basic transmitter and receiver electronics including a drilled and plated PC board. The units work at 23KHZ with a range of 20 ft. and can be positioned opposite each other or side-by-side and bounced off a solid surface. The output will sink up to 300ma to drive a relay, alarm circuit, etc.

ORDER US–01 $19.95

1 HY TOROID POT CORE COILS
ULTRA STABLE FOR LOW FREQUENCY OSCILLATORS, FILTERS, etc.

.49

WARBLE ALARM KIT A piercing 10 WATTS of dual tone noise that can't be ignored. Perfect for burglar alarms, warning devices, or to call your kids home for supper! Complete with PC Board. Less speaker or switch. Requires 6 to 15 VDC. $2.50 COMPLETE

METAL PROJECT CASES

CASES ARE HEAVY GAUGE ALUMINUM WITH BAKED WHITE FINISH & BLACK WRINKLE TOPS.

	A	B	C	
Small:	2 7/8"	x 2¾"	x 1¼"	$1.60
Medium:	4¼"	x 2¾"	x 1 7/8"	2.15
	SHADOW FRONT			
Medium:	4 13/16"	x 3¼"	x 2"	3.50
Lyge:	7"	x 4"	x 2 3/8"	4.35

GUARANTEED!

RETESTED
UNMARKED FUNCTIONAL DEVICES

POSITIVE REGULATOR 500ma. VARIABLE FROM 3 to 30 VDC
7560 – 50c
NEG. REGULATOR (same as 7560 but for negative) 7563 – 40c
DUAL REGULATORS +/– 500ma
7568 – 69c

AUDIBLE CONTINUITY TESTER

Code Practice Oscillator
Continuity Checker
Transistor, diode or LED checker
Tone varies with resistance

$1.95 (kit)

MEASURE CONTINUITY & RESISTANCE TO 2K TEST LED's, DIODES, AND TRANSISTORS. LESS SPEAKER.

Requires 3 to 6 volt batteries (not included)

PHONE ORDERS ACCEPTED ON BAC OR MC CARDS
ALL COMPONENTS AND KITS GUARANTEED.
48 HOUR FAST SERVICE
CATALOG INCLUDED WITH EACH ORDER, OR SEND A STAMP
ORDERS OVER $50.00 TAKE 10% DISCOUNT

WHAT HAVE YOU MISSED?

The back issues of 73 are a gold mine of interesting articles . . . just take a look at what's been covered . . . every possible interest. This is the most important library you can have for hamming.

The supply of these back issues is very limited . . . and when these are gone, that will be it. Don't miss out by procrastinating.

Single issues ..... $1.50 each (before 1976)
Ten back issues (your choice) ..... $12 postpaid in US.
Twenty-five back issues (your choice) $20 postpaid in US.
Twenty-five back issues (our choice) $10 postpaid in US.

JUNE 63. Surplus issue: DMQ-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band-spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, 85 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VE9 hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter use, transceiver power supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce rhombic, 6M exciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state trouble-shooting, IC freq counter (many errors & omissions), "or" transformers, space comm odyssey, pulser info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gene, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW dummy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M sb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio-controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propegation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic toe, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic varlac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, band-switching Swan 250 & TV-2, 88mh selectivity, match exercises, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part II), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper-mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SSQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, renovating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm dope & repeater guide, meggering your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx aligner, 5/8 wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage-stamp 6M tx, extra class study (part 16), Bishop IFNL, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, ehvironment & coax loss, 2-el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid-state vhf exciter, delta-fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 5), "transi-test" (no good — errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero-beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, veractor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise blanker, repeater problems, Motorola HT mods, microwave repeater linking, digital ID unit, tuneable 2M fm rx/tx, repeater directory, fm marketplace, meter evaluator, varactor modulator, simple sig gen, touchtone hookup, hf preselector, 10M 12W tx.

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple af filter, 1-tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket-pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat-sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater car, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gndplane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf pwr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi-power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log-periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW-2 meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 60/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant scoupler, Motorola HT info, SSTV-ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp-compressor, single-IC rx, "432-er" final assembly, transistor keying circuit, 7-segment readout with nixie driver.

APR 74. Vox for repeaters, tone-operated relay, hf transverter, 10-to-2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), ex warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

photo-flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.5 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi-power lo-pass filter, 6M preamp, 3-wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pod hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone

Since there's little to get stale in back issues of 73 (our magazine is not padded ... like others ... with reams of activity reports), you'll have a fantastic time reading them. Most of the articles are still exciting to read ... and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted ... and more. You'll really get a kick out of the back issues.

pole beam support, rhombic antennas, 1974 index.

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar 7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16-wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

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Briefs

Business use of repeater autopatches continues to be a topic of debate nationally. For example, a note from K2CFG: "Due to what can only be described as a gross oversight by our technical committee, repeater trustee, and board of directors, it would seem that WR2ADM is not only on the wrong frequency but actually licensed in the wrong radio service. Everyone concerned with filing the applications for 25-85 acted on the obviously incorrect assumption that this was to be an amateur repeater, operating under FCC rule 97.3 (b), which defines amateur radio communication as, 'radio communication by or among amateur radio stations solely with a personal aim and without pecuniary or business interest.'

"The steadily increasing amount of distinctly business-related conversation on our repeater puts the licenses of all concerned in jeopardy. While it is perfectly legal to mention in conversation the nature of your job and where you work, it is equally *illegal* to exchange names of customers on whom you call or might call, prices and availability of products or services you buy or sell, or itineraries of planned or completed business trips. Even more serious is the use of the repeater for the taking of orders for amateur radio, photographic or any other equipment, or an announcement of the availability of same at bargain prices.

"Please — support your local telephone company — let's keep our repeater in the amateur radio service." *Reprinted from the* LIMARC LOG, *bulletin of the Long Island Mobile Amateur Radio Club, October, 1976.*

On October 15, AMSAT/OSCAR 6 celebrated its fourth anniversary. Launched in 1972 from Vandenberg Air Force Base as ballast for the ITOS-D weather satellite, OSCAR 6 had an expected life of one year. More than three years after its expected demise, it shows no signs of giving up.

November 15 was another birthday. AMSAT/OSCAR 7 was two years old. In the hopes of further conservation of battery power, Mode B orbits that fall on GMT Mondays have been designated QRP, with a recommended power limit of ten Watts ERP. AMSAT officials have asked all OSCAR users to limit their power to 100 Watts ERP, in an effort to extend the life of both satellites.

It appears that the reported sale of General Class licenses in the US is a hoax. An article published August 15 in the *Indianapolis Star*, and subsequently reported in *HR Reports*, said a government employee with access to FCC computers had allegedly offered to have licenses issued by feeding the information to the computers. Groups of amateurs were reportedly selling the tickets for $200 by telling prospective recipients that they could circumvent the usual testing procedures.

O. Franklin Lowry, the FBI agent-in-charge in Indianapolis, told *73* that although the investigation is continuing, it appears that the report is a hoax. Lowry said the bureau has been unable to uncover any evidence of the alleged sale. Citing the fact that he has received numerous queries from members of the press, Lowry theorized that the same person who reported the attempted sale to the FBI also called in the press.

On a higher level, the situation was much the same. A well-placed FCC source, when queried by *73*, said he hadn't even heard of the investigation.

Two major manufacturers of ham equipment have announced an end to field warranty service stations. Drake and Icom have opted for centralized facilities, which means the dealer who sold the radio can no longer repair it! The rig must be sent to a regional repair center, and thus the amateur may face substantial delay. The only other option is for the amateur to forget the warranty and pay for his own repairs. Factory authorized service (non-warranty) will still be available at many dealers. Drake, meanwhile, has set up a western service center in Las Vegas, apparently to take the load off their Miamisburg OH factory.

Word form Down Under has it that ZL stations have been authorized an additional 10 kHz segment of 160 meters. Just in time for winter DXing — look for ZLs between 1803 and 1813 kHz.

Harry Boyle, an air traffic controller at the Tucson International Airport, might have felt a little funny. There he was, guiding a light plane into the approach pattern, talking to the pilot about altitude and wind vectors and such . . . on the telephone. It was the first landing by phone in the airport's history, although it wasn't planned that way.

Fred Chitwood W9YJX/AM7, a Phoenix engineer, was en route to Tucson in his light twin-engine plane when the radio quit. "Around Picacho peak, I realized I was talking to myself," Chitwood said. "Kind of a warm and comfy feeling, you know."

But Chitwood had his trusty 2m HT handy, and called for help via WR7AIM. Bart Paine K7CC was monitoring the repeater at the salt mines, and quickly dialed up the airport tower via autopatch. In all, it took only 14 minutes from Chitwood's call for help until he touched down on the Tucson landing strip. *Reprinted from the* Tucson Daily Citizen, *with thanks to K7QYN.*

Low band openings may have been few and far between this summer, but VHF-UHF activity was a different story. WAS on 2 meters, and WAC on EME were among the summer season standouts. What records will fall next only time will tell, but it seems that 432 WAS and DXCC may not be far away.

EME, tropospheric ducting, and meteor scatter were among the simplex tools used by KØMQS in his 10 year quest for 2 meter WAS. The last contact was K6YNB/KL7 via moonbounce, with Idaho, W7UBI, number 49. Dick ran a full gallon in racking up the first WAS, 2 meter style.

EME was also the focus of the Mt. Airy VHF Club DXpedition to Colombia, South America, in late July. The Pack Rats hauled more than 1200 pounds of gear into Santa Veronica July 25th. Using a 208 element antenna for 432 and a full gallon, the crew provided K2UYH number six for the first ever WAC on 432. Signing HK1TL, the Pack Rats made 16 contacts in 8 different countries, operating a total of nine days, including 20 meter liaison with stateside and OSCAR. (See article this issue.)

The new 10,000 MHz DX record stands at 323 miles, after G4BRS and GM3OXX completed a two-way QSO between Cornwall and Edinborough. On 2 meters, the first USA-Bermuda contact was achieved between W1NU/VP9 and K1HTV, September 14th. If you're after Bermuda, try 144.09 around 0100Z.

Following is the text of a telegram sent to President Ford from the ARRL on July 9:

"We are concerned about persistent reports that a special committee, said to be acting upon instructions from the White House, might recommend withdrawal of vital frequencies actively used by the amateur service in order to create a new general radio service apparently desired by certain commercial interests. The more than one quarter million licensed, qualified, and law abiding radio amateurs of the United States request your assurance that frequencies now assigned to the amateur radio service will be respected and protected by the United States Government. (s) Harry J. Dannals, President, ARRL."
Reprinted from the Lockheed Employees Recreation Club Bulletin, *September, 1976.*

No more portable or mobile designations when IDing after November 26th . . . that's the latest from the FCC. Docket 20686 was approved in mid-October, after the Commission decided there really wasn't any need for amateurs to indicate their operating status. In conjunction with 20686, amateurs will no longer have to notify the FCC in advance when operating away from their permanent station addresses for extended periods. Keep in mind that it is still a prime requirement for all licensees to keep the FCC informed of their mailing addresses, especially if mail won't be forwarded during extended portable operation. The new ruling does not prohibit use of portable or mobile designations, and most contest operation will probably still require it. The one exception to all this is foreign amateurs operating in the states. They will have to continue signing portable or mobile and location, in accordance with Part 97.313.

A new plan for slowing up the hamburglar . . . hams who have lost their Icom radios should send driver's license number, name, address, model and serial number, plus any distinguishable mods or markings, to their nearest distributor. The idea is actually the brainchild of K5CYB, a US Treasury agent based in Dallas. Icom will supply the data mailed to them from amateurs, and Dave will plug it into a data bank to be used as a supplement to the national NCIC (National Crime Information Center) in Washington.

It is apparent that the old music playing days on 75 meters may have spread to the CB band. K4AWS reports an article published in an Orlando FL newspaper:

"Religion took to the CB airways Sunday in Kissimmee. An unidentified church choir group took to channel 19, and sang hymns for several minutes. A spokesman for the FCC office in Miami said there had been no complaints and no investigation had been launched."

Reports have reached *73* that Kentucky police are enforcing the state's anti-scanner law. Under the statute, it is illegal for anyone to use a scanner on the public service bands, while in motion. The law has been loosely interpreted to cover stationary mobile as well! Kentucky law agents are reportedly confiscating scanners and handing out stiff fines to drivers.

SSTV enthusiasts can still receive pictures relayed from the Viking spacecraft on Mars. James Lumsven of the Jet Propulsion Laboratory Amateur Radio Club in Pasadena, California, says that members of the club relay the Viking pictures via SSTV on an average of three days a week. Pictures are transmitted on 14.250 MHz between 2330 and 2630 GMT. Nearly one hundred members of the club are involved in the relay, which commenced in late June and is expected to continue until the end of the year and possibly beyond.

NEW 73 BOOKS

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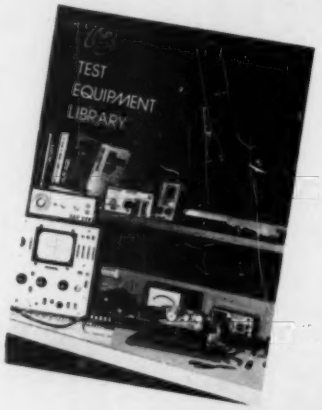

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SN 7437N	.28	SN 74142N	3.50	SN 74192N	.84
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SN 7447N	.67	SN 74153N	.70	SN 74251N	1.40
SN 7448N	.76	SN 74154N	1.13	SN 74279N	.80
SN 7450N	.24	SN 74155N	.80	SN 74283N	5.60
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SN 7452N	.25				
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SN 7472N	.30				
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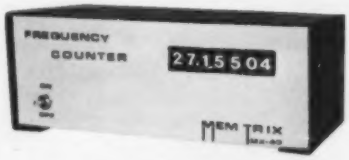

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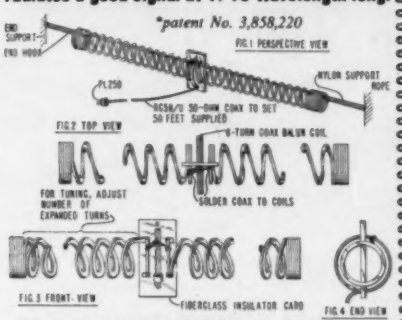

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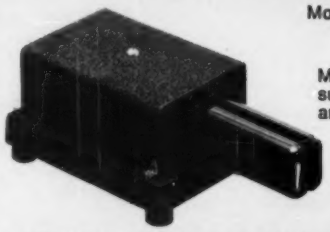

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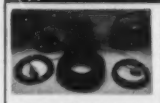

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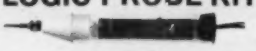

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T-200	120			2.00	3.25
T-106	135			1.06	1.50
T-90	55	45		.90	.90
T-68	57	47	21	.68	.65
T-50	51	40	18	.50	.55
T-25	34	27	12	.25	.40

RF FERRITE TOROIDS

CORE SIZE	MIX Q1 μ = 125	MIX Q2 μ = 40	SIZE OD (in.)	PRICE USA $
F-240	1300	400	2.40	6.00
F-125	900	300	1.25	3.00
F-87	600	190	.87	2.05
F-50	500	190	.50	1.25
F-37	400	140	.37	1.25
F-23	190	60	.23	1.10

Charts above show uH per 100 turns. Use iron powder toroids for tuned circuits. Use ferrite toroids for broadband transformers. Q1 for .1-70 MHz, Q2 for 10-150 MHz.

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7402	.21	7474	.30		
7404	.18	74H74	.75		
74H04	.30	7475	.50		
7405	.24	7476	.30		
7406	.25	74L78	.70		
7408	.25	7480	.50		
74H08	.30	7483	.50		
7410	.18	7490	.50		
74H10	.30	7492	.35		
7413	.45	7493	.55		
7417	.35	7495	.65		
7420	.16	74L95	1.00		
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74L54	.25	74193	1.00		
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739	STEREO AMPLIFIER DIP	.50
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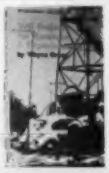

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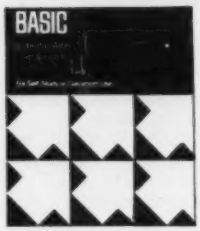

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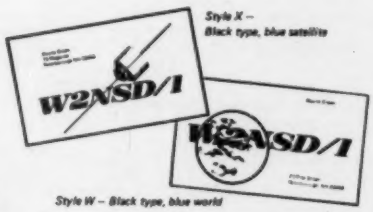

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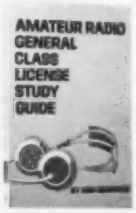

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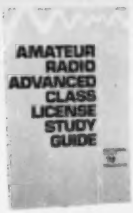

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6 WPM This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly – under pressure – faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five. Practice this one during lunch, while in the car, anywhere and you'll be more than prepared for the easy FCC exam.

14 WPM Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test you'll thank heavens you had this back breaking tape.

21 WPM Code is what gets you when you go for the Extra Class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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There's a revival of interest in constructing low power CW transmitters. Low power does not necessarily have to equate with crude or inconvenient to operate. Most operators desire automatic antenna changeover, and most would like a form of keying that'll silence the receiver while transmitting, yet quickly and automatically restore the receiver when there's a pause in keying. As a bonus, it's pleasing to have the oscillator stay on continuously while the receiver's silenced, and turn off when you've sent that dah-dit-dah and started listening.

All these desirable characteristics can be incorporated into your transmitter with little work and very, very little expense. In fact, most of the needed parts probably are collecting dust in your "hellbox" right now.

Here's what you'll need. Five diodes that'll handle 20 or 30 volts and a couple hundred milliamperes. A pair of electrolytic capacitors, at least 15 or 20 volts and the more microfarads the better. Two more capacitors, these 35 or 40 volts, one of moderate capacitance and the other very large indeed. A dc relay (maybe you'll need several in parallel to switch all the circuits you're planning) of the 24 volt "buck a bushel" variety that clutters up every hellbox; check it out to confirm that it'll follow the usual pattern of pulling in at about 15 volts and not dropping out until the voltage is reduced to around ten volts. You might have to buy that one big capacitor, but all the other items should be available from your collection or mooched from a friend, one who'll thank you for reducing his inventory.

Take a look at the schematic wiring diagram. Note that it uses 6.3 volts from a filament transformer, jacking it up with a rectifier-tripler. The multi-contact relay can be used to key the oscillator ON and hold it in that state as long as you're transmitting, to transfer the antenna from receiver to transmitter, and to silence the receiver. Don't try to add an additional function of a sidetone keyer. Better use an rf-powered tone generator for that! The hold-in time of the relay is determined by the capacitance of the output capacitor working in conjunction with the dc resistance of the relay. Because of this latter variable, it's not feasible to assign a value to the capacitor. You'll have to experiment until you find what it takes to hold the relay in the brief period that is compatible with your operating habits. To eliminate sparking at the key contacts (originating from the keyer and not the transmitter), a low-value resistor (15-30 Ohms) is used in series with the output rectifier. (The rectifier serves to isolate the keyer from the keyed stage.) Another diode isolates the keyed stage from the keyer's voltage supply.

The keyer can be built on a small piece of perfboard, small enough to be tucked away in most any transmitter.

The use of this keyer will make operation of a simple transmitter almost as convenient as using a sophisticated transceiver. It'll richly repay the small effort of building it. And, besides, building is fun! ■

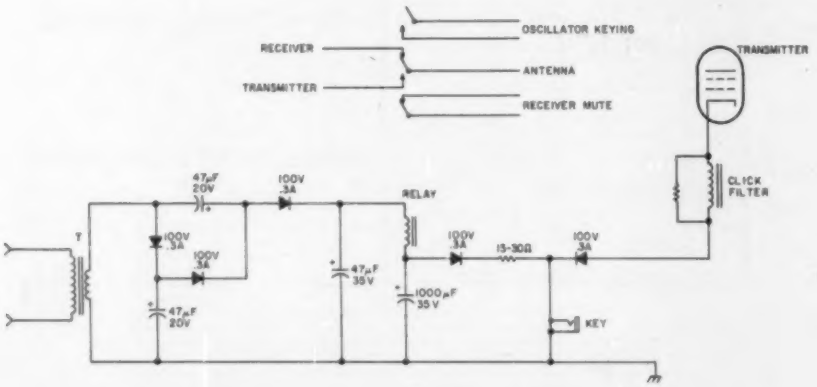

Fig. 1. Relay, multi-pole, double throw, with a coil that pulls in the armature at 15 volts and has a 10 volt armature dropout point.

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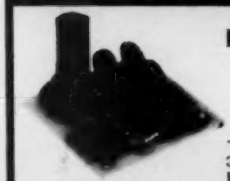

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Corrections

"PROGRAMMABLE CW ID UNIT"
(October, 1976)

Some suggestions in conjunction with the "Programmable CW ID Unit" published in the October issue of *73 Magazine* on page 52: It has been found that for some unknown reason, the switch debouncer circuit will not prevent bounce when the clock is fed from IC1-11 as shown. The fix, if the unit you build has this problem, is to remove the wire from IC1-11 and move it to IC4-10. As an electronics engineer, I must confess I don't fully understand why the debouncer doesn't debounce at that point, or why it does at the other point, which is (logic-wise) the same, but if you find you have the problem, that's the fix.

Another suggestion is to change the values of C1 and R2. As shown, nothing is wrong, but the .47 uF capacitor is an awkward value forcing a large capacitor or an electrolytic capacitor. A better choice is to replace C1 with a .05 uF disc ceramic, and replace R2 with a 1 meg variable resistor. These value changes give the same range and in no other way affect the operation of the circuit.

There are no other known errors or problems with the circuit other than that my mail tells me that many people are having trouble getting the MC14562CP shift register. This IC may be obtained from me for $10.00 including shipping, or a complete set of all ICs required may be obtained for $13.50.

C. Warren Andreasen WA6JMM
Post Office Box 8306
Van Nuys CA 91406

"BAUDOT TO ASCII"
(November, 1976)

I just received my November *73*, which includes my Baudot to ASCII conversion program. And, of course, I immediately noticed that I let a few errors slip by when I reviewed the proof you sent me. The only error likely to cause any problems occurs in line 440 of the program. This line should be corrected to read:

```
00440 0831 65 80 BITA = $80 test bit 7 set?
```

Of course, I corrected the error when I first ran the program – but forgot about it when running off the copy to send to you. Naturally, a programmer with several months experience and a thorough knowledge of the program would immediately spot the error.

My check for a charter subscription to *Kilobaud* is enclosed. Sounds like a good place for me to share some of my happy experiences with my SWTPC system (and maybe a few of the frustrating moments too!).

Mark Borgerson
Corvallis OR

"SIMPLE GRAPHICS TERMINAL"
(September, 1976)

Please note the corrections to my article as shown in bold on the accompanying schematics. In addition, the caption for Fig. 2 should read "A1-A10 – pin 7 to +15 V . . ."

Steve Ciarcia
Glastonbury CT

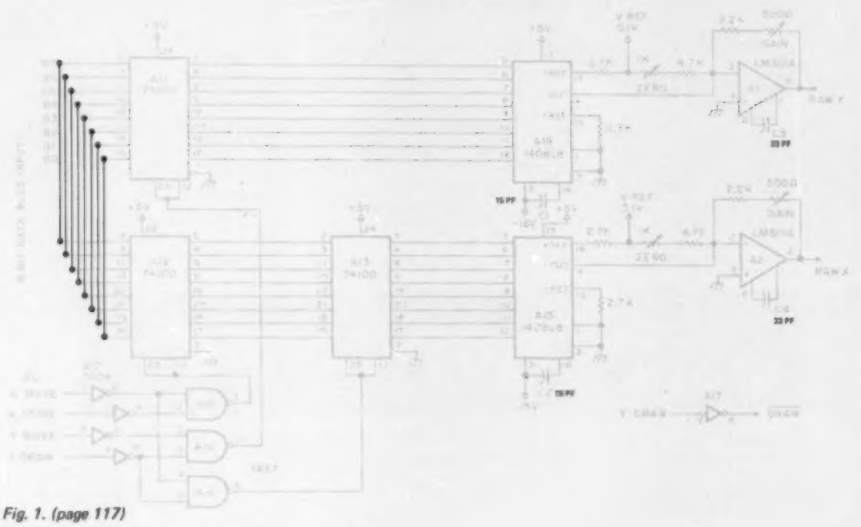

Fig. 1. (page 117)

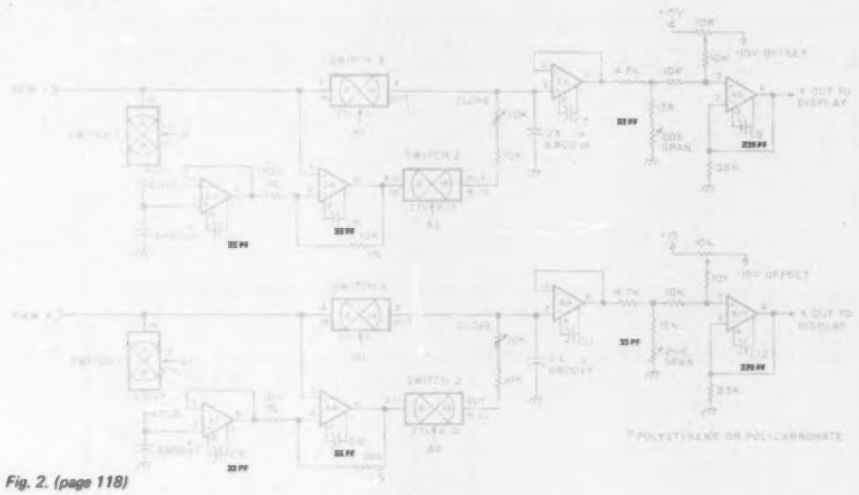

Fig. 2. (page 118)

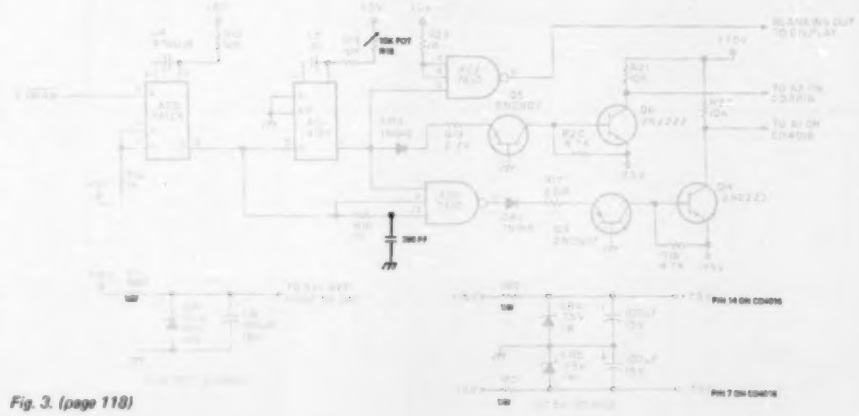

Fig. 3. (page 118)

"THE S38 IS NOT DEAD!" (November, 1976)

There's apparently an error in one of my circuits ("The S38 Is Not Dead!", November, 1976, Fig. 1, page 88). A dropping resistor (18k Ω, 1 W) was left out, between the +100 V bus and the cathode of the 33 volt zener diode.

Hank Olson W6GXN
Menlo Park CA

"ASCII/BAUDOT WITH A PROM" (June, 1976)

To builders of the BAC-2 Baudot-ASCII converter: The purpose of this letter is to document all the known "bugs."

1. Pin 1 of U8 goes to pin 10 rather than pin 14. This sets up a start bit by pre-clearing the 7474 to a zero. This was a bug in the *TTL Cookbook* by Lancaster that I garbled in drawing my diagram (I had found it in my original unit).

2. B4, B5, and B6 go to pins 5, 6, 7 on U6 (8223), rather than pins 4, 5, and 6.

3. In Fig. 4, B5 goes to pin 12 (not 11) and B6 goes to pin 11 (not 12).

Since the article was published, an outfit came out with a board to convert the CT-1024 (TVT-2) to a 64 character line (still 16 lines down the page). It really works well on my unit and improves the performance tremendously. They want $5 for a small board and you supply a 74193, 7485, 7404, and 7400, and a .1 uF cap. It takes about 2 hours to install the modification. The address is: Digital Designs, Box 4241, Victoria TX 77901.

They also have the circuitry worked out to add scrolling, but stated they were not sure if people were interested. The board for this would sell for about $16. If you are interested, please let them know so that they decide to go into production (I want one too!!).

Hope this is of some help and that your unit is working for you. Please send an SASE, which I'll keep on file if any other developments come up.

Dave Guthrie W8LNY
2956 London Wall
Bloomfield MI 48013

NEW PRODUCTS: EICO DLP-6 (December, 1976)

My apologies for having neglected to include the accompanying Interpretation of Indicators table with my review of the EICO DLP-6.

Dr. Jack W. Crenshaw
Huntsville AL

Indicators			Meaning
High	Low	Pulse	
Off	Off	Off	Open Circuit
Off	On	Off	Dc Logic Low
On	Off	Off	Dc Logic High
Off	On	On	Low with short, regular high pulses (more frequent than 4 Hz)
On	Off	On	High with short low pulses
On	On	On	Square or rectangular waves (Relative brightness of high and low indicators gives a rough measure of duty cycle)
On	Flashing	Flashing	Logic high with intermittent low pulses (If pulses are less than about 1 ms, flashing of low indicator will be invisible)
Flashing	On	Flashing	Logic low with intermittent high pulses

AMSAT

AMSAT-OSCAR 6 AND 7 ORBITAL DATA CALENDAR

In cooperation with AMSAT, Skip Reymann W6PAJ has published an improved AMSAT-OSCAR orbital data calendar containing all orbits for 1977 for both AMSAT-OSCAR 6 and AMSAT-OSCAR 7. Designed so that it may be hung on the wall, the calendar includes information on the operating schedules and frequencies for both spacecraft, and also the telemetry decoding equations. Also included is step-by-step information on how to determine times of passage of the two satellites.

The orbital calendar is available postpaid for $5.00 U.S. funds or 30 IRCs ($3.00 to AMSAT members, and free to AMSAT Life Members). Overseas orders will be airmailed. Orders and payments should be made to Skip Reymann W6PAJ, P.O. Box 374, San Dimas CA 91773. Please include a gummed, self-addressed label with your order to speed up processing.

Proceeds from the orbital calendar benefit AMSAT.

SCHEDULE CHANGE

Effective October 3, 1976, all GMT Sunday descending node (southbound) passes of AMSAT-OSCAR 6 have been considered as *on* passes. The transponder will be turned on by AMSAT telecommand stations whenever possible so these orbits can be used for two-way communications. The reason for adding these additional passes is because the satellite's orbit is such that AO-6 is in total sunlight according to NORAD tracking data. Our telemetry from AO-6 indicates that the temperature on board is still rising and is almost at a peak which would confirm the NORAD data. Because of this, it is necessary to keep the transponder on for additional orbits to help keep the battery from overcharging and thus overheating. Even though the satellite will be in total sunlight for a number of months to come, it can't be left on all the time since the solar arrays can't provide all the power required to run the transponder. The battery must provide the balance of the power required, and can't do this if it is not allowed to be recharged on a regular basis. This is the reason for the scheduled *off* days.

The new schedule for AMSAT-OSCAR 6 is: The transponder will be turned *on* for two-way communications by users on all ascending node passes on Mondays, Thursdays and Saturdays and for all descending node passes on Sundays, GMT. This schedule of *on* orbits will remain in effect until further notice. If the battery voltage drops below a certain point (a telemetry channel 3A count of 52), the AMSAT telecommand stations have been instructed to turn the transponder off immediately.

I4SN (left) and DJ4ZC (right) inspect a model of the frame for the Phase III spacecraft at a recent AMSAT meeting held at Greenbelt, Maryland.

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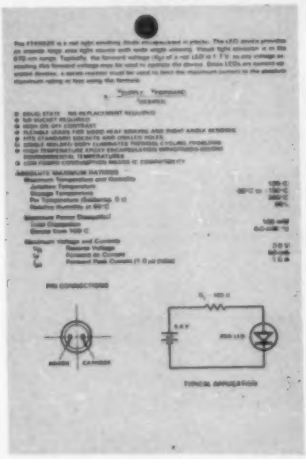

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LM311N	.90	NE531N	3.00	LM556N	1.65
LM318CN	1.50	NE536T	6.00	LM7525N	.99
LM319N	1.39	NE540L	6.00	LM7535N	1.25
LM320K-5	1.39	NE560N	.79	80368	4.95
LM320K-5.2	1.39	NE565V	.45	LM7545D	.99
LM320K-12	1.39	NE5609	5.00	75451CN	.39
LM320K-15	1.39	NE5618	5.00	75452CN	.39
LM320T-5	1.75	NE5620	5.00	75453CN	.39
LM320T-5.2	1.75	NE5634	1.25	75454CN	.39
LM320T-8	1.75	NE5636	1.75	75491CN	.79
LM320T-12	1.75	NE5636CN	1.25	75492CN	.89
LM320T-15	1.75	NE5637N	1.95	75494CN	.99
LM320T-18	1.75	NE5637V	1.99	**RCA LINEAR**	
LM320T-24	1.75	LM703CN	.45	CA3013	2.15
LM323K-5	9.99	LM709H	.29	CA3032	2.54
LM324N	1.89	LM709N	.29	CA3035	2.48
LM339N	1.70	LM710H	.79	CA3039	1.39
LM340K-5	1.99	LM711N	.39	CA3046	1.30
LM340K-6	1.99	LM723H	.55	CA3059	3.25
LM340K-8	1.99	LM723N	.55	CA3060	3.25
LM340K-12	1.99	LM733N	1.00	CA3080	.95
LM340K-15	1.99	LM739N	1.69	CA3081	2.99
LM340K-18	1.99	LM741CN	.35	CA3082	2.99
LM340K-24	1.99	LM741CN	.35	CA3083	1.99
LM340T-5	1.75	LM741HM	.99	CA3086	.95
LM340T-6	1.75	LM747H	.79	CA3089	3.75
LM340T-8	1.75	LM747N	.79	CA3091	10.20
LM340T-12	1.75	LM748H	.39	CA3123	2.15
LM340T-15	1.75	LM748N	.39	CA3130	1.39
LM340T-18	1.75	LM13003N	.50	CA3140	1.25
LM340T-24	1.75	LM13048N	1.19	CA3600	1.75
LM350N	1.00	LM13056N	1.49	RCA194	5.95
LM351CN	.85	LM13078N	.85	RCA195	3.25

74LS00 TTL

74LS00	.39	74LS74	.65	74LS151	1.55
74LS02	.39	74LS75	.79	74LS153	1.69
74LS03	.45	74LS76	.65	74LS157	1.55
74LS04	.45	74LS78	.65	74LS162	2.25
74LS05	.45	74LS83	2.19	74LS163	2.25
74LS08	.39	74LS85	2.49	74LS164	2.25
74LS10	.39	74LS86	.69	74LS175	1.95
74LS13	.79	74LS90	1.25	74LS181	5.00
74LS14	2.19	74LS92	1.25	74LS190	2.65
74LS20	.39	74LS93	1.25	74LS191	2.65
74LS26	.49	74LS95	2.19	74LS192	2.65
74LS27	.45	74LS96	2.19	74LS193	2.65
74LS30	.49	74LS98	1.49	74LS194	2.25
74LS32	.49	74LS107	.65	74LS195	2.25
74LS40	.49	74LS112	.65	74LS257	1.69
74LS51	.39	74LS132	1.55	74LS298	.59
74LS55	.39	74LS136	.65	74LS279	.79
74LS73	.65	74LS138	1.69	74LS670	5.95

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.95

ALL THREE HANDBOOKS $6.95

100 PER STRIP MOLEX PINS

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies.

SPECIAL — 100/1.49 — 1000/12.00

CONSUMER ELECTRONICS

PONG $55.00 SINGLE GAME
SUPER PONG $79.95 4 GAMES IN ONE

PONG

FOR YOUR HOME TV

GAMES INCLUDED IN SUPER PONG ARE:

- PONG
- CATCH
- SUPER PONG
- HANDBALL

FEATURES OF PONG AND SUPER PONG

- Incremental speed on volleys increases excitement.
- Playing field adjusts to any size screen.
- Game appears in color or in black & white, depending on television set.
- Unmistakable "PONG" sound accompanies each volley.
- Digital scoring flashes on the screen between each point.
- 2 player challenge or Solitaire
- Hooks up simply to any model television set; the screen actually becomes the playing field.
- English and other techniques can be used to make any member of the family a Pong champion.
- Battery operated by 4 size "D" flashlight batteries included with the Unit.

AC Adaptor (Eliminates Batteries) $9.95

ATARI

DISCRETE LEDS

	.125" dia.				.187" dia.				.200" dia.				.300" dia.	
XC209	Red	10/$1		XC525	Red	10/$1		XC555	Red	10/$1		XC111	Red	10/$1
XC209	Green	4/$1		XC525	Green	4/$1		XC555	Green	7/$1		XC111	Green	4/$1
XC209	Orange	4/$1		XC525	Yellow	4/$1		XC555	Yellow	7/$1		XC111	Yellow	4/$1
				XC525	Orange	4/$1		XC555	Orange	7/$1		XC111	Orange	4/$1
				XC525	Clear	4/$1		XC555	Clear	7/$1				
XC22	.200" dia. Red	10/$1												
XC22	Green	4/$1												
XC22	Yellow	4/$1												
XC22	Orange	4/$1												
SEL-62	RT	4/$1												

	.187" dia.			.200" dia.			.300" dia.	
XC525	Red	10/$1	XC555	Red	10/$1	MV50	.185" dia. Micro	
XC525	Green	4/$1	XC555	Green	7/$1			
XC525	Yellow	4/$1	XC555	Yellow	7/$1		hat LED	
XC525	Orange	4/$1	XC555	Orange	7/$1		6/$1	
XC525	Clear	4/$1	XC555	Clear	7/$1			

DISPLAY LEDS

DL707 DL339

TYPE	POLARITY	HT	TYPE	POLARITY	HT	
MAN 1	Common Anode	.270	2.05	MAN 3620	Common Anode-orange	.300	1.75
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 3640	Common Cathode-orange	.300	1.75
MAN 3	Common Cathode	.125	.39	MAN 4710	Common Anode-Red	.400	1.95
MAN 4	Common Cathode	.167	1.95	DL701	Common Anode-red ±	.300	1.85
MAN 7	Common Anode	.300	1.25	DL704	Common Cathode	.300	1.50
MAN 7G	Common Anode-green	.300	1.95	DL707	Common Anode	.300	1.50
MAN 7Y	Common Anode-yellow	.300	1.95	DL 728	Common Cathode	.500	2.95
MAN 82	Common Anode-green	.300	1.75	DL 747	Common Anode	.600	2.25
MAN 84	Common Anode-red	.429	1.75	DL 750	Common Cathode	.600	2.49
MAN 72	Common Anode	.300	1.25	DL 338	Common Cathode	.110	.99
MAN 74	Common Cathode	.300	1.99	FND70	Common Cathode	.250	.75
MAN 82	Com.ion Anode-yellow	.300	1.75	FND503	Common Cathode	.500	1.00
MAN 84	Common Cathode-yellow	.300	1.75	FND507	Common Anode	.500	1.00

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin	$.17	.16	.15
14 pin	.20	.19	.18
16 pin	.22	.21	.20
18 pin	.29	.28	.27
22 pin	.37	.36	.35

	1-24	25-49	50-100
24 pin	$.39	.37	.35
28 pin	.46	.44	.43
36 pin	.60	.59	.58
40 pin	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24
16 pin	.30	.27	.25
18 pin	.33	.32	.30
24 pin	.49	.45	.40

28 pin	$ .59	.56	.51
36 pin	1.39	1.28	1.15
40 pin	1.59	1.49	1.39

SOLDERTAIL STANDARD (GOLD)

8 pin	$.36	.27	.24
14 pin	.35	.32	.29
16 pin	.38	.35	.32
18 pin	.52	.47	.43

24 pin	$ .70	.63	.57
28 pin	1.10	1.00	.90
36 pin	1.75	1.49	1.35
40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.41
18 pin	.75	.68	.62

24 pin	$1.05	.95	.85
28 pin	1.49	1.25	1.10
36 pin	1.99	1.45	1.30
40 pin	1.75	1.55	1.40

WIRE WRAP TOOL Part Number WSU-30 $5.95 ea.

WIRE WRAP WIRE

30 AWG — 25 ft. min. - $2.10 50 ft. - $2.75 100 ft. - $3.50 1000 ft. - $24.00

SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM			1/4 WATT 5% — 50 PCS.
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM			
ASST. 2	5 ea.	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM			1/4 WATT 5% — 50 PCS.
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1K		
ASST. 3	5 ea.	470 OHM	560 OHM	680 OHM	820 OHM	1K			1/4 WATT 5% — 50 PCS.
		1.2K	1.5K	1.8K	2.2K	2.7K			
ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K			1/4 WATT 5% — 50 PCS.
		8.2K	10K	12K	15K	18K			
ASST. 5	5 ea.	22K	27K	33K	39K	47K			1/4 WATT 5% — 50 PCS.
		56K	68K	82K	100K	120K			
ASST. 6	5 ea.	150K	180K	220K	270K	330K			1/4 WATT 5% — 50 PCS.
		390K	470K	560K	680K	820K			
ASST. 7	5 ea.	1M	1.2M	1.5M	1.8M	2.2M			1/4 WATT 5% — 50 PCS.
		2.7M	3.3M	3.9M	4.7M	5.6M			

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) $10.95 ea.

XR-2206KA KIT $17.95 EXAR XR-2206KB KIT $27.95

TIMERS		PHASE LOCKED LOOPS		WAVEFORM GENERATORS		STEREO DECODERS		MISCELLANEOUS	
XR-556CP	$ .69	XR-210	5.39	XR-205	8.40	XR-1310CP	$3.29	XR-2211CP	6.70
XR-320P	1.95	XR-215	6.60	XR-2206CP	4.49	XR-1310EP	3.29	XR-4136	2.00
XR-558CP	1.65	XR-567CP	1.95	XR-2267CP	3.95	XR-1800P	3.29	XR-1488	3.95
XR-2556CP	3.29	XR-567CT	1.79			XR-2567	3.99	XR-1489	5.99
XR-2240CP	3.25							XR-1469	4.99
								XR-2206	5.29

All Advertised Prices Good Thru December
Satisfaction Guaranteed. $5.00 Min. Order. U.S. Funds.
California Residents — Add 6% Sales Tax — Data Sheets 25¢ each
Send a 24¢ Stamp (postage) for a Free 1977 Catalog

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SPDT — SERIES PB, PB1

Maintained Action Switch
Push To Make Contact, And
Push Again To Reserve Action

Momentary Action Switch
Normally Open or Normally
Closed. (For N.C. circuit use
terminals 2 & 3, for N.O. 2
& 3; for N.C and N.O. 1,2,&3

PUSH BUTTON

PB-123 $1.75

PB-126 $1.75

5 AMP RATINGS

THUMBWHEEL SWITCHES

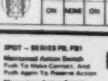
THUMBWHEEL SWITCH ONLY

		Price
SP-12	Single 10 Position	$2.95
SA-12	Decimal	$2.95
SP-21	10 Position BCD only	$3.95
SPA-21		$3.95

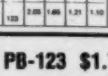
Ordering: Order desired switch or switches and add necessary accessories for your particular application.

SP — Front Mount SR — Rear Mount

SERIES SP Front Mount Assembly



SERIES SR Rear Mount Assembly



ACCESSORIES

Part No.	Description	Price
SP-DP	End Plate (Pair)	$1.00
SP-DSP	Double Post (each)	.40
SP-BB	Blank Body (each)	.40
SP-HB	Half Body (each)	.40

ACCESSORIES

Part No.	Description	Price
SR-EP	End Plate (pair)	$ .60
SR-DSP	Double Post (each)	.40
SR-BB	Blank Body (each)	.40
SR-HB	Half Body (each)	.40

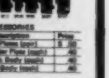
DIP SWITCH

These switches feature seven SPST slide switches in a molded tray. They are ideally suited for microprocessor applications.

$1.95

CLIPLITE !! 4/$1.00

NEW LED MOUNTING SYSTEM



- CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".
- CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.
- CLIPLITE is to be used with XC556 LEDS.
- Specify colors—red, green, amber, or yellow when ordering.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006*	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N5008	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N5008	15	400m	4/1.00	1N4305	75	250M	20/1.00
1N5232	5.6	500m	2/$	1N4734	5.6	1w	2/$
1N5234	6.2	500m	2/$	1N4735	6.2	1w	2/$
1N5235	6.8	500m	2/$	1N4736	6.8	1w	2/$
1N5236	7.5	500m	2/$	1N4738	8.2	1w	2/$
1N456	25	40m	6/1.00	1N4742	12	1w	2/$
1N458	150	7m	6/1.00	1N4744	15	1w	2/$
1N4054	180	10m	5/1.00	1N1183	50 PIV	40 AMP	1.00
1N4001	50 PIV	1 AMP	12/1.00	1N1124	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1186	150 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	IN1188	200 PIV	35 AMP	1.90
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C30D	15A @ 400V	SCR	$1.95
C35N	35A @ 200V	SCR	1.95
2N3206	1.6A @ 200V	SCR	.59
MDA 980-1	25A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	25A@ 200V	- FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	$.61		PN2907	2/$1.00	PN2222	4/$1.00
MPS A06	$.61		PN3565	4/$1.00*	PN2222A	4/$1.00
2N3702	4/$1.00		PN3568	4/$1.00*	2N4401	4/$1.00
2N3821	4/$1.00		PN3569	4/$1.00*	2N4402	4/$1.00
2N3823	$.61		2N3704	5/$1.00	2N4403	4/$1.00
2N3904	5/$1.00		2N3705	5/$1.00	2N4410	5/$1.00
2N3906	5/$1.00		2N3706	5/$1.00	2N4888	4/$1.00
2N3707	5/$1.00		2N3708	5/$1.00	PN4123	4/$1.00
2N3708	5/$1.00		2N3709	5/$1.00	2N4124	4/$1.00
2N3711	5/$1.00		2N3710	5/$1.00	2N4125	4/$1.00
2N3904	4/$1.00		2N3724	$ .65	PN5089	4/$1.00
2N3905	4/$1.00		2N3725	$1.00	2N5129	5/$1.00
2N3903	5/$1.00		2N3903	4/$1.00	2N5130	5/$1.00
2N3904	5/$1.00		2N3904	4/$1.00	2N5139	5/$1.00
2N3905	$ .61		2N3905	4/$1.00	2N5172	5/$1.00
MJE3055	$1.03		2N3906	4/$1.00	2N5210	4/$1.00
MJE2955	$1.03		PN4013	3/$1.00	C106B1SCR	2/$1.00
2N3390	5/$1.00		PN4014	3/$1.00	2N5432	$2.50
2N3391	5/$1.00		PN4126	5/$1.00	2N5457	1.75

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.033µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.13	.17	.13
.0047mf	.12	.10	.07	1mf	.37	.23	.17
.01mf	.12	.10	.07	22mf	.33	.27	.22

+20% -10% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.29	.23	.17	1.5/35V	.39	.28	.21
.15/35V	.29	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.29	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.29	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.29	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.29	.23	.17	10/25V	.40	.35	.29
1.0/35V	.29	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

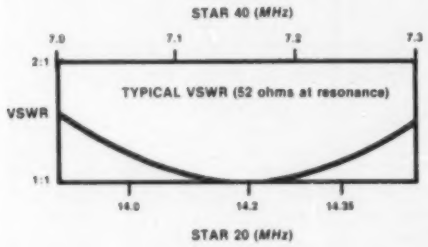
Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.15	.14	.11	.47/35V	.15	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.14	.12
4.7/25V	.16	.14	.13	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/35V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
33/50V	.24	.20	.18	4.7/50V	.15	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.19	.14	.12
100/50V	.35	.30	.26	47/25V	.24	.21	.19
220/25V	.32	.28	.25	100/10V	.19	.15	.14
220/50V	.45	.41	.36	100/25V	.24	.20	.19
470/25V	.32	.29	.27	100/50V	.35	.30	.26
1000/10V	.35	.30	.25	220/16V	.23	.17	.15
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

The STAR SERIES

NOTICE
PRICE INCREASES EFFECTIVE JAN. 31, 1977
STAR 15 : $39.95
STAR 20 : $44.95
STAR 40 : $54.95

Star 20 shown (mast not included)

The STAR Series provides a new dimension of antenna size, shape and versatility for today's ham. The success of these antennas is based on their combination of performance and small physical size. Ideal for apartments and urban installations having limited space, the STAR is an antenna even a neighbor can appreciate. □ The STAR antennas are modified magnetic loops* (not halos or electrical loops) with the benefits resulting from this design. The extremely low E/H ratio in the near field eliminates the need for a ground plane or radials and greatly reduces absorptions and ground losses. A shaped RF current distribution along the driven element produces resonance and a nominal 52 ohm input impedence directly, without the use of lossy matching networks or loading coils. A low angle of radiation results and sharp nulls are formed which can be oriented to minimize QRM. No antenna resonances occur at harmonics of the fundamental, suppressing TVI radiation. The above factors combine to produce a horizontally polarized signal with gain over a vertical or dipole, wide bandwidth, and low noise pickup. STAR antennas can be phased to provide gain and directivity comparable to a two element beam. The antennas are circular in cross section with spokes radiating from the mast hub to provide rigid support. The antenna elements are protected within a rugged polyvinyl chloride frame which can be painted. When horizontally polarized, wind survival is in excess of 100 mph. The STAR series of antennas are capable of handling legal power and can be mounted for either horizontal or vertical polarization. The STAR 20 and the STAR 40 can be stacked vertically on a single mast if desired.



To introduce the STAR antennas at the lowest cost, they are available factory direct only from the address below. Complete instructions are provided for assembly and tuning for optimum performance at your QTH. State whether the STAR 20, STAR 40, or both are desired. Send check or money order to the address below. California residents add 6% sales tax. Antennas will be shipped by UPS.

*J.M. Boyer, "The Surprising DDRR Low Noise Antenna," 73 Magazine, September 1976, pp. 42-45.

STAR 20 (20 meters): $39.95
Weight: 10 pounds
Dimensions: 46" diameter x 2.5" depth

STAR 40 (40 meters): $49.95
Weight: 20 pounds
dimensions: 90" diameter x 2.5" depth

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BARREL KIT #160 V. REGULATORS 15 for $1.98 LM309KC TO-3 V.R.'s harvested. Hot by the pound. No. 1A3330

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BARREL KIT #144 RCA PHONO PLUGS 40 for $1.98 1,000,000 RCA phono plugs for this one. You hi-fi-ers know wut they are . . . 100% material. 1A3293

BARREL KIT #143 75-PC TRANSISTORS $1.98 100% material, TO-92, factory discontinued lines, pap's mixed with spec. 2N4400-1-3-5-4. 1A3290

BARREL KIT #140 LAMPS, INDICATORS 20 for $1.98 Precision mini lamp all-metal, panel, with mtg hardware. Lamp maker's overstock. No. 1A3297

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BARREL KIT #137 AXIAL ELECTROS 40 for $1.98 Asst. capacities and voltages. Cap No. 1A3227

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BARREL KIT #117 2 OPTICAL FIBERS one 20-Mil. 200-FT. $1.98 Fiber optics factory bankruptcy purchase! High quality, most-commonly used size (20-mil). CLEAR.

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BARREL KIT #112 MICRO MINI LEDS 40 for $1.98 All the tiny leds, axial, right of Monsanto, Litronix, variety of colors. Yield 50% or better. 1A3128

BARREL KIT #109 TERMINAL STRIPS 100 for $1.98 Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb Cat. No. 1A3136

BARREL KIT #105 MINI VOLUME CONTROLS 25 for $1.98 1-Million pcs of 100%, 50K mini pots, ceramic case, long shaft. Kept make No. 1A3088

BARREL KIT #104 SLIDE VOLUME CONTROLS 10 for $1.98 Cat. No. 1A3057

BARREL KIT #103 RESISTOR SPECIAL 200 for $1.98 Includes: ⅛, ¼, ½, 1, 2 watters, carbon. 5 ozs. 100% good. 1A3054

BARREL KIT #99 PHOTO ELECTRIC CELLS 10 for $1.98 Asst. GE types, CDS types. Mixed by factory. Big fish for us to separate. 100% good. Cat. No. 1A 3032

BARREL KIT #93 HALF WATTERS 200 for $1.98 Resistor factory tried to trout us by mixing 100% color-coded resistors in barrel. But value is there, good ole. 1A3046 Untested

BARREL KIT #92 3 AMP EPOXY RECTIFIERS 100 for $1.98 Cosmetic rejects, electrically fine. business! You check 'em; it's not for us. Asst. voltages. Untested 1A3233

BARREL KIT #91 SILVER MICAS 100 for $1.98 Axial, red case, variety of physical sizes & values. Cat. No. 1A3018

BARREL KIT #88 LITRONICS LED READOUTS 10 for $1.98 747's, 727's, singles, triples, .33 to 0.6. Bot from factory, all mixed; have fun! No. 1A2991

BARREL KIT #87 NATIONAL IC BONANZA 100 for $1.98 Types 8000, 7400 series, DTL, ROMs, registers, clock & calc. chips, linears, etc. Cat. No. 1A2982 Untested.

BARREL KIT #86 HOBBY LEDS 40 for $1.98 Untested. Wow! A Litronics dump of all kinds of mixed discrete LEDS, shapes, colors, good, poor, etc. 1A2939

BARREL KIT #83 15 for $1.98 LM-340T VOLT REG Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat. 1A2931

BARREL KIT #82 MIXED READOUTS 10 for $1.98 Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. Cat. No. 1A2733 Untested.

BARREL KIT #81 POLYSTYRENE CAPS 100 for $1.98 Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat. No. 1A2739

BARREL KIT #76 1-WATT ZENERS 100 for $1.98 Factory same as 400-mw's. Never-to-see-again offer. 6, 8, 10, 12, 15V. under glass. Double plug. Cat. No. 1A3741 Untested.

BARREL KIT #75 400MW ZENERS 150 for $1.98 Factory out of bis! Amazing offer: 3, 6, 10, 12 to 15V. You test. Hermetically sealed glass pak. Double plug. Cat. No. 1A2740

BARREL KIT #73 TRANSISTOR ELECTROS 50 for $1.98 We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 1A2747

BARREL KIT #71 CAPACITOR SPECIAL 100 pcs. $1.98 micas, molleds, plastics, ceramics, discs, etc. Nifty 100% good Cat. No. 1A2728

BARREL KIT #68 2 WATTERS 100 for $1.98 100% good. All marked. Cat. No. 1A2736

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BARREL KIT #58 SLIDE SWITCHES 30 for $1.98 All shapes, sizes, spst, dpst, thumpsticks, etc. Tremendous shop pak for 100's of switching projects. Cat. No. 1A2726 100% good

BARREL KIT #56 POWER! POWER! 100 for $1.98 Large distributor cleaned house. Barrels of power resistors 5 to 7 watts. Cat. No. 1A2724

BARREL KIT #54 8 DIGIT READOUTS 10 for $1.98 Bargain of a lifetime! All we got was 1 barrel — the "blister digit" types. Multiplexed. Cat. No. 1A2722

BARREL KIT #46 G.E. 2.5 WATT AMPLIFIERS 25 for $1.98 Hobby type, factory fallouts. 1A2624 Untested

BARREL KIT #40 PNP HIGH-POWER TRANSISTORS 20 for $1.98 Popular germanium TO-3 case 1A2618 100% good

BARREL KIT #39 1N3015 HOBBY TRANSISTORS 15 for $1.98 Fallouts of the famous 2N3055. 1A2617 100%

BARREL KIT #37 2 AMP "BULLETT" RECTIFIERS Untested 100 for $1.98 Famous style, metal, voltages, silicon, axial includes all types of voltages to 1KV. Cat. No. 1A2613

BARREL KIT #35 NEON LAMPS 30 for $1.98 100% good. Famous NE-2's. All prime, but factory made millions, and barrel'ed 'em. Your advantage Cat. No. 1A2613

BARREL KIT #33 METALLIC RESISTORS 100 for $1.98 Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tol. & a barrel of values. Cat. No. 1A2609

BARREL KIT #31 PREFORMED RESISTORS 200 for $1.98 We got barrels of ¼ and ½" watters for pc use. 150: ¼, 100 ½" watters. No. 1A2608 100% good

BARREL KIT #26 PLASTIC TRANSISTORS 100 for $1.98 Untested. Type TO-92 (TO-18), all manufacturers. variety of 2N #'s. Cat. No. 1A2596

BARREL KIT #25 METAL CAN TRANSISTORS 100 for $1.98 Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked etc. Cat. No. 1A2603 Untested.

BARREL KIT #24 2N3055 HOBBY TRANSISTORS 15 for $1.98 Fallouts of the famous 2N3055. 1A2617 100%

BARREL KIT #20 LONG LEAD DISCS 100 for $1.98 "auction sale". Prime, marked only. Long leads Cat. 1A2598 100% good

BARREL KIT #19 DIPPED MYLARS 60 for $1.98 Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat. No. 1A 2597 100% good

BARREL KIT #17 LINEAR & 7400 DIPS 100 for $1.98 Untested. Marked and unmarked, internal numbers of raw factory stock. No. 1A2431

BARREL KIT #15 MOSFET TRANSISTORS 60 for $1.98 All 4 leaders TO-18 case, includes UHF transistors too! Cat. No. 1A2429

BARREL KIT #14 PRECISION RESISTORS 200 for $1.98 Marked and unmarked ⅛, ¼, ½, 2 watts. No. 1A2428

BARREL KIT #12 POWER TAB TRANSISTORS 40 for $1.98 PNP, plastic TO220 type. Assorted 2N numbers. Cat. No. 1A2426 Untested.

BARREL KIT #11 POWER TAB TRANSISTORS 40 for $1.98 NPN, plastic TO220 type. Assorted 2N numbers No. 1A2425 Untested.

BARREL KIT #10 ROMS-REGISTERS 75 for $1.98 28 to 40 pin devices, marked, internal factory numbers etc. 1A2424 Untest.

BARREL KIT #8 SUBMINIATURE IF TRANSFORMERS 100 for $1.98 Amazing, includes slugs, can, antenna, who knows? From transistor radio manufacturers. 100% 1A2422

BARREL KIT #7 VOLUME CONTROL BONANZA! 30 for $1.98 100% good Singles, duals, variety of values, styles, big ones — small ones. Cat. No. 1A2421

BARREL KIT #4 "4580" RECTIFIERS 100 for — Untested. 1N4000 series. May include 50, 50, 100, 200, 400, 600, 800 and 1000 voltsre. 1A2417

BARREL KIT #3 1N4148/914 SWITCHING DIODES 100 for $1.98 Imagine famous switching diodes at these prices! Cat. No. 1A2418 Untested.

BARREL KIT #2 LINEAR OP AMPS, DIPS 75 for $1.98 Untested. May include 709's, 74**'s, 703's, 560 series, 565 includes Cat. No. 1A2416

BARREL KIT #1 SN7400 DIP IC'S 75 for $1.98 Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters. Cat. No. 1A 2413 Untest

BARREL KIT #5 SCRS, TRIACS QUADRACS 40 for $1.98 Raw factory stock! All the 10 amp types. Cat. No. 1A2419 Untested.

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SN7404N	.16
SN7408N	.16
SN7409N	.20
SN7410N	.20
SN7411N	.25
SN7413N	.45
SN7417N	.49
SN7420N	.25
SN7421N	.39
SN7422N	.35
SN7427N	.35
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SN7437N	.35
SN7438N	.35
SN7440N	.16
SN7441N	.84
SN7442N	.83
SN7445N	.99
SN7446N	.99
SN7447N	.99
SN7448N	.76
SN7450N	.16
SN7451N	.16
SN7454N	.16
SN7460N	.16
SN7472N	.25
SN7473N	.34
SN7474N	.34
SN7475N	.49
SN7476N	.31
SN7478N	.79
SN7483N	.99
SN7485N	.86
SN7486N	1.05
SN7489N	.44
SN7491N	.73
SN7492N	.47
SN7493N	.47
SN7494N	.78
SN7495N	.78
SN7496N	.72
SN7416SN	.99
SN74173N	1.39
SN74174N	.57
SN74175N	.99
SN74179N	.79
SN74180N	.79
SN74181N	2.05
SN74184N	1.75
SN74185N	1.75
SN74190N	1.15
SN74191N	1.05
SN74192N	.87
SN74193N	.83
SN74195N	.72
SN74196N	.86
SN74198N	1.49
SN74199N	1.49
SN74200N	1.95
SN74221N	1.29
SN74284N	5.95
SN74285N	5.95
SN7415N	.99
SN74161N	.70
SN74164N	.79
SN74165N	.99
SN74173N	1.39
SN74174N	.57
SN74175N	.99
SN74179N	.79
SN74180N	.79
SN74181N	2.05
SN74184N	1.75
SN74185N	1.75
SN74190N	1.15
SN74191N	1.05
SN74192N	.87
SN74193N	.83
SN74195N	.72
SN74196N	.86
SN74198N	1.49
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I/O EDITORIAL

from page 74

That afternoon Sherry and I drove out to visit her folks in nearby Seguin, Texas. I hadn't seen them but once since I'd visited them in Ft. Worth back in 1949 while I was working at a television station in Dallas, so we had a great reunion ... capped by a fantastic veal curry dinner (my best curry recipe came from Sherry's mother Alma). Sherry's father, Snuffy Smythe, had worked with my father back in the early 40's, so we'd all known each other for almost 35 years.

The next day we flew up to Austin and visited the Motorola plant there, where they make memory chips and 6800s. We were taken through the plant and watched them make the chips — a process that is largely automated. The silicon bars are grown, turned down on a lathe, sawed into thin slices about 3" in diameter, and then the building up of the layers of circuits is started, going from one bay of the building to the next for each layer, carried on cushions of air along an intricate production line ... with microscope checkpoints after each operation.

We had a great time talking with the Motorola gang, including Mike Wiles (the Mike of MIKBUG), Joe Magee (who will be writing for us), Irwin Carroll, John Beyer, George Foote, Mike Hadley, Joel Boney ... several were active hams. The Austin Motorola plant is their LSI center. Only one sour note: *no* free samples! How frustrating to see those thousands of great chips just on the other side of a window.

SUBMARINE REUNION

Next we flew into Mobile, Alabama, where we joined a reunion of members of the crew of the *USS Drum* (SS-228). Eighteen of us turned up for the get together aboard our old World War II home, which is anchored beside the battleship *Alabama* as a memorial to the war. The last time I'd seen my old boat was around 1956 during a convention in Washington when it was included as one of the attractions for visiting. It was used as a school boat at that time.

I hadn't seen anyone from the crew since 1946 — thirty years. What a bunch of *old* men!

We reminded each other of the funny things that had happened during our year or so together ... the time Skinny Guinea, the cook, was discovered trying to put the stew back in the pot after the boat had taken a tremendous lurch and spilled it all over the galley deck. Or the time Skillet (another cook) found his food storage lockers filled up and kicked the remaining supplies overboard one night rather than bother to return them. The missing supplies turned out to be mostly sugar, so we made a 60-day war patrol without sugar ... until we managed to flag a passing submarine (one of ours) and swap some of our hydraulic oil for sugar. Picture two submarines off the coast of Japan (not very far off) passing oil and sugar across between them in the middle of the night.

I've got enough good sea stories from my five war patrols on the *Drum* to fill half a book — I think I'll see if the other members of the old crew can come up with enough more to make a complete book. I've never heard of a book written by the crew of a ship before.

ATLANTA

The Computer Systems Center opened up specially for us on Sunday and we had an opportunity to rap for quite a long time without interruptions. Richard Stafford, Ron Roberts, Steve Mann and Jim Dunion are making good headway toward developing small business operating systems for use on microcomputers such as the Altair and the Intelligent Systems unit. They have programs developed for an accounting system (general ledger, invoicing, accounts receivable, accounts payable, payroll), a word processing system and an inventory system. These are the first business systems I've seen and they give us a good idea of what is coming.

We wanted to see the Intelligent Systems plant (where they make those full color video terminals), so we drove out to their new factory and met Terry Hughey, the president. He has a small assembly system going there and was shipping both kits (with enormous instruction manuals) and assembled units. This terminal has an 8080A built in, so it has rather impressive possibilities. I got the impression that not much software was yet available. I think most of the programs so far written were done by the Computer Systems Center. There was no question that I really had to have one of those gorgeous full color terminals.

The prices of the systems were a bit confusing. In single lots I think they were going for around $2500 ... in bulk for $1995. They had a special coming up for $1775, but I later got the impression that this was a bare bones system ... this was further impressed on me when our unit arrived along with a bill for $4550 (we wanted some accessories). We were hoping that we could furnish color terminals with our Publishers Data computer system which we hope to sell soon, but we may have to go with the Lear-Siegler terminals in glorious black and white.

We are in the final stages of programming our computer system at *73* ... it will take care of subscriptions, renewal notices, billing for subs, prospective subscribers, bulk accounts for radio stores and newsstand wholesalers, space advertising records and billing, payroll, general ledger, reader's service, profit and loss, an article index, repeater list, and a dozen more functions. Everything is on line at all times and the system is handling eight terminals.

Since our system is far less expensive than anything else I've seen anywhere, I think we'll have quite a few publishers interested in it. We'll be selling it complete with all hardware and programs. We're expecting to have several hundred customers for the system since it does just about everything and costs so little.

It was a most interesting trip. We had a chance not only to see how the firms I visited last year have progressed, but to talk with them and get their perspective on how the industry is doing and where they think it is going. A lot of this is influencing the thrust of *Kilobaud* magazine.

As time permits, we'll try to get out and contact newer firms in the field and let you know what's going on.

New Products

THE HAL SYSTEM

It hardly takes any time at all using a Teletype machine for I/O before you are ready to put in some sort of video terminal ... *any* type of video terminal. Practically speaking, this means a choice between a Southwest Technical Products CT-1024, the HAL Communications system, or the Lear-Siegler. Let's, for the time being, take a good close look at the HAL system.

What are we looking for in a terminal? We don't want to spend any more money than we have to, yet we want something which will do a professional job. The HAL AK8-1005 keyboard and RVD-1005A TV driver come assembled and tested (a big plus for many hobbyists) and are nicely packaged in good looking boxes ... nothing Mickey Mouse about it.

We want a keyboard that is well laid out — with the return key easy to use, not where you have to move your hand to touch it (for this usually means you have to check the keyboard visually to get back typing again). The HAL keyboard is very easy to use. One great feature (which you generally find in only the more expensive keyboards) is the "n-key rollover." This allows you to hold down as many keys as you want and have the characters sent out when you release them. This feature makes the keyboard a lot faster to use.

Only a couple of things were missing ... a "repeat" key which permits a character to be repeated when both it and the character are held down at the same time ... and a bell or some audio tone. A tone is nice as a signal when a cassette file is found. There is a connection for a bell or tone, if you want to put it in yourself.

Hobbyists will want to know how difficult it is to interface the HAL system. It should virtually plug into most computers, since it has a standard RS-232C interface, 110 baud, 11 bit word, no parity and local echo. Changing baud rates is a bit complicated, requiring a clock crystal change.

Other options which are changeable by jumper are:

Local echo (normal)
No local echo
No parity check (normal)
Even parity check
Odd parity check
Variable baud rate (normal)
High speed clock
Negative true input (parallel) (normal)
Positive true input (parallel)
Ten unit output (1 stop bit) (normal)
Eleven unit output (2 stop bits)

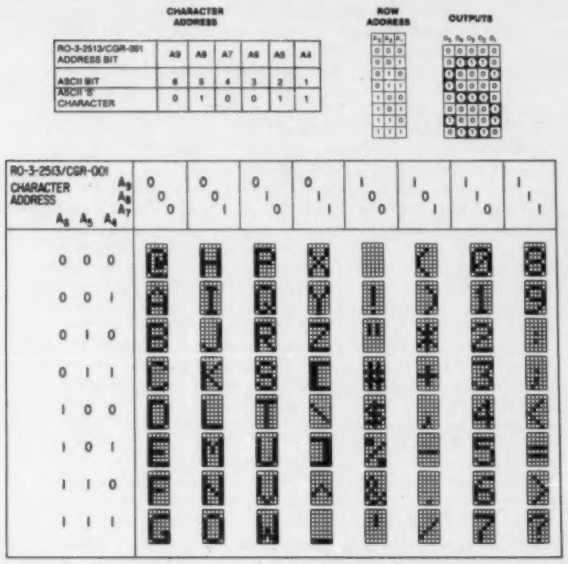


Fig. 1. RO-3-2513-001 standard pattern character format. The RO-3-2513/CGR-001 is a preprogrammed version of the RO-3-2513 series with ASCII encoding and the character font shown above. A logic "1" represents an input or output voltage nominally equal to Vcc (+5 V) and a logic "0" represents a voltage nominally equal to GND (0 V). An example demonstrating the correspondence of device outputs and addressing sequence to the 5 x 7 dot matrix font is shown.

This strapping flexibility offers an easy method of changing the characteristics of the communications device as you improve your mainframe. Although the chips are well marked on the PC boards, the jumpers are not. With no UART as a landmark, it will take just a little looking to find the applicable jumper. The lands for these jumpers are on the bottom side of the board. This prevents the movement of jumpers without first removing the board. At first this looks like a disadvantage, but actually it is not. If the lands are on the top surface of the PC, there is a great temptation to make modifications to a board mounted in its chassis. Working in a confined space is difficult and conducive to solder splashes and other solder errors which may go undetected. The HAL board must be removed in order to make jumper changes. There are 3 nylon stakes, 2 screws and 2 dip sockets holding the board in the chassis. It takes less than a minute to get the board out and in the open, where it can be worked on with plenty of room and good lighting.

The RVD-1005A is designed to plug into a TV monitor with a BNC connector. Most solid state TVs and many tube-type TVs can be connected if coupled through a capacitor to the base or grid of the first video amplifier. This should be attempted on ac isolated sets only. If you are a customer of HAL, and you send them a schematic of the TV you are using, they will sketch out the details.

The clarity of the display is a function of the TV of monitor size, focus, contrast, and the character generator chip that HAL has chosen for their device. The HAL format is 25 lines per page, 40 characters per line, and each character in formed by a 5 x 7 dot matrix. The character generator chip is a 2513 made by National Semiconductor and General Instruments. Fig. 1 shows the correlation of the ASCII binary to the character as displayed. This character set in the HAL format produces a very legible display on any size screen.

The character set encoded by the keyboard is a product of another LSI chip, this time found on the keyboard PC in the AKB-1005. The MM5740AAE by National Semiconductor encodes the depression of the key by row and column. This chip is a 90 character device and generates normal, shift, control and shift control mode characters. There are no deficiencies in this character set for standard applications.

The hobbyist who is going to be getting into it and changing the baud rate and word size will find that the PC boards are orderly and clean, with the parts well numbered. The boards do not have a solder mask, so extra care should be taken when working with a soldering iron. The instruction manual contains all the prints and theory necessary to get you around the boards.

And now for the bottom line. The AKB-1005 keyboard is priced at $100; the RVD-1005A at $375. If you plan to rack mount the TV driver, be sure to specify RVD-1005AR.

In a market that is so sorely hurting for good yet inexpensive CRT devices, HAL Communications Corporation makes well-packaged, well-engineered equipment at affordable prices. *HAL Communications Corp., Box 365, Urbana CA 61801.*

James Muehlen
Computer Lab Director

ICOM IC-202 AND IC-502 PORTABLE SSB TRANSCEIVERS

The first vestiges of winter come early to southern New Hampshire. Only the week before, the countryside had been ablaze with crimson and yellow hues. But now, the situation was completely different. Sitting on top of Pack Monadnock mountain, a fierce wind gusting to over fifty miles per hour buffeted the car and bent trees and metal road signs. All this for the middle of October.

Who, you may ask, would spent the afternoon in a place like that on such a blustery day? A ham, of course! By my side sat two new rigs from Icom. If you're one of those amateurs who is sick and tired of the crowded conditions on repeaters and the low bands, you need simmer no longer. These rigs are for you.

Sideband activity on six and two meters is increasing every day. There's still plenty of time to get into these wide open areas. The IC-202 covers 144.0-144.4 MHz, the IC-502 50.0-51.0 MHz. Both units operate USB and CW, with 3 Watt output feeding quarter wave whips. The 502 is a hair larger than the 202, with both approximating the size of the well-known 22A. Nine batteries add to the weight, but both weigh in at a reasonable 4½ pounds. Padded shoulder straps make the carrying job a little easier.

The lack of a suitable winter coat and the associated gear necessitated the rigs be tested by putting the whip antennas through a partially open car window. On two meters, a bit of tuning and a few CQs brought a QSO with a station in the Boston area, some 80 miles away. Later, on six meters, a station in the Springfield MA area answered my call, also about 80 miles away as the buzzard flies. Both stations reported crisp and easily readable signals. With the pleasurable QSOs, the freezing of toes and bones was soon forgotten. Both rigs were extremely easy to tune and drifted not at all during the half hour contacts.

Activity on these bands is still not very heavy. But enough stations are around to find contacts anytime without the worry of being QRMed out of the shack. Reports from the west coast confirm an even greater interest in this hassle-free part of the spectrum. These new radios should be responsible for a big increase in sideband use.

There are several minor nit-picking points on the minus side. The one Watt audio output to the two inch speaker makes it a bit difficult to read in a mobile that's underway. If you

lack an extension speaker, the earphone included with the units makes for much better copy. Another minor inconvenience is CW operation: On every go around, the CW transmit switch must be returned to the receive position. Finally, the aforementioned problem of weight. Although 4½ pounds may not seem like much, after a day of climbing the rocks and hills, it begins to feel much heavier. I found it easier to carry under the arm like a book.

Regardless of those minor inconveniences, these units have been ready-made for the ham on the go, be it in the hills of New England or the city. The VHF twins are made to the usual high standards of Icom gear and have no troubles standing up to the rigors of portable operation. They seem to be built like the rocks that they were inadvertently bumped against, without any adverse effect. The owner's manuals are complete down to every last detail. A fold-out schematic with indicated voltages makes for easy troubleshooting without a magnifying glass or strained eyes.

Included with both rigs are batteries, mike, earphone, strap and mike carrying case, as well as miniature plugs for power supplies, external speaker and CW key.

Turning to specs, both the IC-202 and IC-502 receivers have sensitivity of better than .5 uV for 10 dB S+N/N. Intermod rejection is better than 60 dB. The i-f is 10.7 MHz. The transmitters feature a filter type SSB producing system with spurious suppression of over 40 dB.

There's still plenty of room on two and six meters, and these units from Icom are just the radios to create new interest. Just looking at them sitting on a table gives you the urge to go out and climb a mountain. If you're not in the mood to do that, a power supply, linear, and external antenna make them perfect base stations. The 202 even has two empty crystal positions and can be used for the OSCAR uplink.

The 202 retails for $259.00, the 502 for $249.00. *Icom East, Inc., Suite 307, 3331 Towerwood Dr., Dallas TX 75234; Icom West, Inc., Suite 3, 13256 Northrup Way, Bellevue WA 98005.*

Stan Miastkowski WA1UMV
Associate Editor

KENWOOD TS-820

With the latest changes in the amateur rules, equipment manufacturers are working hard on new gear. Low band privileges for Technicians and higher power for Novices mean a bigger market for the manufacturers. After the first of the year there will be several surprises from companies that until now have stayed away from low band gear. Chances are that they will be trying to equal the latest high water mark in amateur transceivers ... the Kenwood TS-820.

The Kenwood is not cheap. After adding up all the accessories, the buyer faces a tab somewhere around $1200. But for his money the owner gets a high quality piece of gear, not to mention the tremendous incentive to upgrade, with SSB and the rest of the bands sitting there waiting for him.

Sure, you can buy less expensive transceivers, but you're going to be hard pressed to find a better value than the 820. It represents the state of the art, and quite frankly it's a fun machine. Look at the 820 as an investment, and consider the years of troublefree operation and pleasure you'll get out of it. As they say, it does pay to go first class. Now, let's take a closer look.

Before long every low band transceiver will probably have digital readout. Once you've used it you'll never want to use the old dial format again. Instantly you know what frequency you're on and, wrapped in a package like the 820, you'll wonder how you got along all these years without it. It's great fun.

The digital readout is a $170 option, but we doubt Kenwood is selling many units without it. It's calibrated down to 100 Hz with 6 bright Kenwood Blue LEDs. Installing the three piece digital option is easy. All the cables are there, and it just takes a few self-tapping screws to complete the job. All connections are failsafe computer type, making it impossible to plug in upside down.

Right out of the box our 820 was within 100 Hz of WWV on 15 MHz. What's more, the 820 has a digital hold (DH) control which allows the operator to lock the LEDs and tune off frequency. To get back to the original frequency all you do is release the hold control (after noting the locked frequency) and tune back to the starting point. A handy device for taking a station off frequency without a remote vfo. There is, however, no magic ... the DH switch will not whisk you back to the original frequency when released (as some on-air QSOs have speculated).

Tuning the 820 is smooth, with no sign of backlash. The standard SSB filter provides good selectivity, with signal separation better than most transceivers. The Kenwood has good sensitivity, and can handle adjacent signals quite well. With the passband tuning, the circuit shifts the i-f passband without changing your receiver frequency and, while it works well, no radio is going to magically clear the QRM; you can only hope to reduce it.

A single conversion system, although new in low band transceivers, gives the Kenwood real immunity to images, overload, and cross modulation. There is a 20 dB front end pad to take care of any serious problems, if you are one of the unlucky ones with another ham living down the street. It seems the 820 will be a popular field day rig, considering its rugged receiver.

On the transmitting end the 820 sets the same kind of pace. Incoming signal reports were fantastic! QSO after QSO brought gratifying reports and much reaction to the radio's excellent audio quality. Several stations even volunteered praise for the 820, without knowing what I was running. DX stations reported substantial improvement in audio punch when using the built-in rf speech processor. Local stations didn't even find the processor objectionable when I switched it in for comparison purposes. A compression level scale is included on the 820's multimeter for proper adjustment, and Kenwood built in an air monitor which allows you to hear yourself. Comforting.

In fact, Kenwood has left practically nothing out. The 820 has front panel controls for VOX, compression level, FSK, a 20 dB front end attenuator, three position AGC switching (slow for SSB, fast for CW, and off for receiving very weak signals), four fixed channels (for MARS or net frequencies), and RIT (for offsetting receive frequency in nets or on CW).

All controls are in a sensible, easy-to-use format. Aside from adding a finger hole for the main tuning knob, I wouldn't change a thing. Ac power supply, speaker and PA blower are built-in. Mobile work requires an accessory adapter, but the 820 isn't too large for most family cars — and would make a fine mobile rig.

Band coverage is complete ... no accessory crystals to buy. 16-10 meters are included, along with 15 MHz for WWV reception, and the rest of the 19 meter SW band as a bonus.

The transmitter is a breeze to tune. I found it to be fairly broadbanded, requiring touch-up only after excursions of over 100 kHz using our 3 element CushCraft 20 meter beam. The PA contains the rig's only tubes, two Japanese equivalents of the 6146 for finals and a 12BY7 driver. Kenwood has provided separate switching for the heater circuitry, a nice feature for portable or mobile operation. I'm sure one of the big reasons why the 820 tunes so easily is the introduction of rf feedback between the PA and driver stages. The Kenwood runs super cool, with a PA fan so quiet I checked twice to be sure it was running. Power output on all bands was greater than 120 Watts, more than enough to drive most linear amplifiers.

Kenwood offers a variety of accessories: remote vfo, 2 meter transverter, 500 Hz CW filter, and (of course) the digital frequency display. Since the standard package includes enough features to put the Kenwood high on any ham's list, it's not hard to understand why dealers are deluged with orders.

Most important, the flexibility is there, and so is the operating pleasure. Without a remote vfo the TS-820 will do just about anything separates can do. With the second vfo it's hard to argue that the rig won't satisfy even the most demanding DX chaser. *Trio-Kenwood Communications, 116 E. Alondra Blvd., Gardena CA 90248.*

Warren Elly WA1GUD/1
Associate Editor

THE ICOM 22S

Cries of "the computers are coming, the computers are coming" will be heard, as more hams get their hands on the new IC-22S. This is, essentially, the best parts of the old IC-22 (which was a darned good rig) plus a synthesizer — a programmable synthesizer.

Up to 22 channels can be set up in the IC-22S by soldering in diodes on a matrix board. This is very handy if you are going from one area to another and want to change the channels so that you don't break any wires going to the matrix or break off the diode leads when you are soldering.

The rig seems to beg for connection to a computer-managed switching unit — just the thing for even the simplest of microprocessors to handle. A little software program to let you select the channel via a touch pad, or perhaps a scanning program. We'll bet that Tom Gentry, one of the bigwigs of Icom East, comes up with something. Tom is deeply into computers these days.

The fact is that we had a tough job getting a 22S to test (without buying one). Dealers are swamped with orders and Icom East is up to here trying to keep up with them. One of the last things they need right now is more people putting pressure on them for radios. In spite of all this, we did manage to get a unit (which had been used for demo at hamfests) and wring it out.

It works.

The larger speaker (than the 22A) results in better fidelity and more audio than most of us can use. The reports on voice quality are definitely better than we get with the IC-230. We ran the 22S and 230 side by side with separate antennas and could see no difference between the receivers — both excellent.

A matrix system for switching is about the same thing as the Read Only Memory (ROM) units in computers. By defining the frequency as a binary number and using diodes as switches, the synthesizer in the 22S is programmable. This means you don't have to buy any crystals. The IC-22S comes with a chart which tells you where to solder in the diodes to get the receive frequency you desire — the transmitter channel (600 kHz split) is then taken care of.

Considering the small size, the 22 channels, and the flexibility of the IC-22S, it is no wonder that dealers are raising cain with Icom to get deliveries for customers. I think we'll be having a lot of good articles on modifications of this rig — first with an outboard switch for remote programming the synthesizer, and then later software control via a microprocessor. We'll see. *Icom East, Inc., Suite 307, 3331 Towerwood Dr., Dallas TX 75234; Icom West, Inc., Suite 3, 13256 Northrup Way, Bellevue WA 98005.*

Warren Elly WA1GUD/1
Associate Editor

LOW COST ACTIVE FILTERS INTRODUCED BY NATIONAL

A new series of low cost active filters designed for use at frequencies up to 10 kHz has been developed by National Semiconductor Corp., according to Brent Welling, marketing manager for hybrid products.

Called the AF100 series, the new integrated circuits are intended for use in low frequency analog systems, including medical, geophysical, sonar, audio, tone signaling, modem, and feedback control systems where specific filter functions are required.

The AF100 series filters are basic building blocks that can be used to construct any filter response, such as Butterworth, Bessel, Cauer, and Tschebycheff. With the addition of only four external resistors, the AF100 can be programmed for second order functions.

Lowpass, highpass, and bandpass functions are available simultaneously at separate outputs, and notch and allpass functions are available by combining these outputs in an internal summing amplifier. If higher order systems are required, several AF100s can be cascaded. In all configurations, the Q, gain, and center frequency adjustments are independent, requiring no iterative trimming.

Other features of the new active filter series include a Q range of up to 500 and a frequency accuracy of either ±1% or ±2.5%. Operating power supply range is from ±5 V to ±18 V and supply current is 4.5 mA max.

The new active filter series is available in either a 16 pin plastic dual in-line package or a 12 pin TO-8 can for operation over the commercial temperature range of from -25° C to +85° C, and in the TO-8 can for operation over the military temperature range of from -55° C to +125° C. In quantities of 100, the commercial plastic DIP active filters with a frequency tolerance of ±2.5% (the AF100-1CJ) sell for $4.95 each. Delivery is from stock. *National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051.*

SECURITY PRODUCTS
KIK-CO "KEEPS IT" SECURITY KIT
SOUTHCOM INC. SLIDE MOUNTS AND FOILER
(see ad, page 50, December, 1976)

An ever-increasing complaint among amateurs is the "missing rig syndrome." It's brought about by the realization that the rig that was innocently sitting in your car a few minutes ago is no longer there. In all probability, that 2 meter rig will end up in a trash can in some back alley after the thief realizes that it's not a CB unit after all.

In an effort to discourage the "rig-ripper-offers," a number of security products are hitting the market. The key point here is the word discourage. No security device makes a rig entirely theftproof, unless you want to lock it away in some underground vault. Many devices on the market capitalize on the assumption that most thieves who filch rigs are in a big hurry. Therefore, anything that extends the time required to remove the rig will supposedly discourage the would-be filcher. The concept is called "controlled access" and it's been used with great success in jails, banks, and other areas that require any great degree of security.

One of the neatest security devices on the market is the "Keeps It"TM security kit made by Kik-Co of Fort Worth, Texas ($14.95). This patented product consists of two panels made of what's called "space age aircraft material stronger than steel." Included in the kit is all necessary hardware for installation. Most radios using standard type brackets can easily be protected by the kit. Two notable exceptions are Icom and Heathkit. Installation of the kit is an easy half hour project using only a standard screwdriver and a special wrench supplied with the kit.

The two panels limit access to the bolts holding the unit by covering them. Also featured are one way head bolts to hold the bracket to the dash, further discouraging the would-be thief.

Some brackets might require a bit of modification.

The massive bracket of my FM-DX required that a couple of holes be drilled in order to fit the protective plates. Removal of the rig is no problem. The special wrench and a screwdriver are required. The whole process takes about a minute.

Another method of discouraging theft is to remove the radio entirely. One of the quickest ways to do this is a slide bracket. Most brackets have been plagued with the problem of interconnecting pins not lining up after a few removals. This problem has been solved by SouthCom. Their heavy duty slide mounts are constructed using heavy steel on plastic guides for smoother operation. This, coupled with the use of computer-type connectors, assures positive connection every time.

Another problem has been power loss and increased swr through inferior connectors. SouthCom's bracket uses a new miniature coax connector. *73* tested the unit with a wattmeter and found zero loss of power.

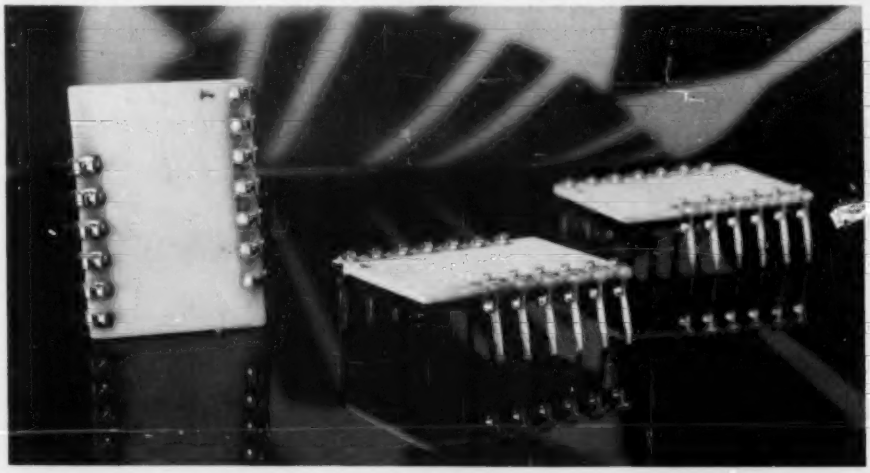
The mount is available in three configurations: the MB-3 for 2-way radios, the MB-2 for tape decks, and the MB-1, which requires wiring. All three include provision for a padlock (not supplied). Prices range from $7.25 to $19.95.

Another SouthCom product is something called the "Foiler." This five dollar unit is used in conjunction with a trunk mount antenna. Two screws mount it to one of the braces under the trunk lid. A latch and stainless steel spring hold the antenna securely to the trunk lid while operating. When stopped, a flip of the latch disengages the antenna and it stows neatly in the trunk. Voila! ... no telltale antenna to announce the presence of an expensive unit within.

Kik-Co, P.O. Box 13249, Fort Worth, Texas 76118.

SouthCom, P.O. Box 11212, Fort Worth, Texas 76109.

Stan Miastkowski WA1UMV
Associate Editor



Will Silver-Zinc Replace the Nicad?

-- portable power with a punch

Sam Kelly W6JTT
12811 Owen Street
Garden Grove CA 92645

The advent of all solid state equipment has resulted in a renaissance for the battery industry. Nickel-cadmium, "alkaline," carbon-zinc and lead-acid batteries are all in widespread use by amateurs. Due to its cost, the silver-zinc cell has seldom been encountered, although it is highly desirable for really portable operations. This type of cell has been extensively used in torpedoes, missiles and space applications.

Recently one of my favorite surplus haunts received a shipment of dry charged Yardney "Silvercell" batteries. The cells were new, sealed and dry charged. Their small size was ideal for one of my portable applications, so I invested in a set not knowing what a bargain I had stumbled on.

The silver-zinc cell has an extremely high ratio of stored energy to weight, a flat discharge curve and an ability to discharge at a high rate without damage. The cell consists of a silver oxide positive electrode and a zinc negative electrode. The electrolyte is potassium hydroxide. A 40% to 45% concentration should be used. Do not use "standard" battery electrolyte, which is sulphuric acid. This would immediately destroy the zinc electrode, giving off hydrogen gas.

To place the cell in operation, the electrolyte is introduced through the vent plug. This can be a tricky and hazardous task. For the small size cells normally encountered, the process is best done in the kitchen sink. Remove the small porous filter from under the vent cap. Make a pipette from a piece of glass tubing, or use an old eyedropper that will fit into the cell.

Simply pouring the electrolyte into the vent tube will result in splashing when the cell burps. The cell should be set in the sink or in a glass bowl to prevent damage from the electrolyte. Remember that the electrolyte is highly basic. It can be neutralized with household vinegar.

After filling, let the cell sit for a while, and then top off with more electrolyte to replace that absorbed by the separators. Carefully wipe any spilled electrolyte from the polystyrene case. Charging of the small size cells, with a less than 25 Amp maximum discharge rate, can be readily done with the dc power supply and battery charger whose circuit is shown in Fig. 1. If the supply is to be used only for battery charging, the filter capacitor can be omitted. Batteries can readily be assembled from individual cells by placing them in series. Room temperature open circuit voltage for charged cells is typically 1.86 volts. The normal voltage spread is such that six cells are used for a 9 volt battery, and 8 or 9 for a 12 volt battery. Charging current should be limited to between 7% and 10% of the rated cell discharge capacity. This value is generally found as part of the identification number printed on the cell. For example, a Yardney HR-5 series means that the cell is designed for a high rate of discharge, and that the design discharge rate is 5 Amps. In this case, charging current should be kept between 350 and 500 mA. Charging should be stopped when the cell voltage rises sharply and reaches 2.05 volts (see Fig. 2). Do not overcharge, as this will greatly reduce the cycle life.

Manufacturers' specifications showed a dry storage life of up to five years. Packing dates on the surplus cells revealed that the cells were 12 years old, yet they charged right up and have performed satisfactorily.

When selecting surplus cells, avoid any that have been in service. Remember, these might pay off for scrap as the silver oxide electrode has a sizeable percentage of

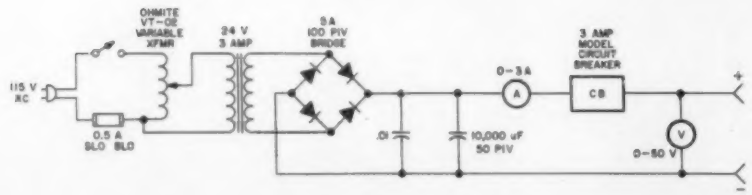


Fig. 1. Dc supply and battery charger.

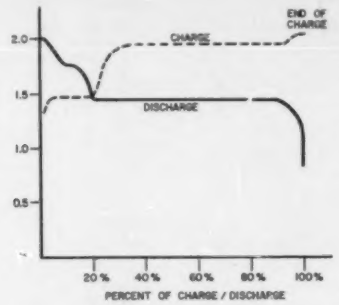


Fig. 2.

recoverable silver when the cell is discharged! Buy only dry charged cells that are unused, and preferably ones that are still sealed from the atmosphere. Once electrolyte has been added, the life span of the cell ranges from six months to two years, with the high discharge cells having the least life span.

My main application for the cells is to power an RF Communications MARS issue RF-403 VHF transceiver. Using 9 Yardney HR-5DC-8 cells results in a handy-pack that could run the set on full transmit (20 Amps) for about 15 minutes of continuous transmission! Since the set draws only 150 mA on receive and about 3 Amps on reduced power transmit, I typically get 10 to 12 operating hours between charges from a package that measures only 2.9 x 1 x 5.3 inches, and weighs only a little over 3 pounds! Obviously, the operating time would depend heavily upon the transmit to receive duty cycle. The size to energy ratio of these little jewels makes it worthwhile to search through your favorite surplus mart and invest in them. ■

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